Curſus Mathematicus:

OR, A

Complete Courſe

OF THE

MATHEMATICKS.

Vol. II.

CONTAINING

Arithmetick and *Trigonometry*;

With Correct and Uſeful TABLES of

Sines, Tangents, and Logarithms.

Written in *French* by Monſieur *OZANAM*, Profeſſor of the *Mathematicks* at *Paris*.

Now done into *Engliſh*.

LONDON:

Printed for *John Nicholſon* at the Queen's-Arms in *Little-Britain*, and Sold by *John Morphew* near *Stationers-Hall*. M DCC XII.

PREFACE.

HAVING laid the Foundation of the Mathematicks in the First Volume; I now present you, in particular, with each part of the wonderful Edifice, which the Mind of Man has erected to be the Palace of his Reason, by which he commands all the Arts, all the Sciences, and all the Circumstances of Life. *Arithmetic*, which makes the first part of this Volume, is undoubtedly the most Extensive, the most Necessary, and the most Subtile of all others. It is the most extensive, because its Subject is infinite, and whatever limits you set to its Figures, it still goes beyond; and whatever divisions are made of its Individuals, it still finds out degrees of advancing its Fractions to Infinity. It is the most useful and necessary, because it is mostly used in Trade and Commerce, and without it, the Operations of the other parts wou'd be defective and uncertain; and if once you understand it throughly, together with the Elements of *Euclid*, you may assure your self, that you,

at the ſame time, poſſeſs almoſt all the other parts of the Mathematics. Laſtly, 'tis the moſt ſubtile, becauſe it goes beyond the Power of Nature; it finds more than the greateſt number poſſible, and leſs than an Unit; it makes Figures, which Nature, as fruitful as ſhe is, cannot produce; and if the *Imagination* diſengages it ſelf from Nature and Matter, in order to make Geometrical Enquiries, and, with more exactneſs, to meaſure Lines, Surfaces, and Solids, the Mind is rais'd by Arithmetic, above *Imagination* it ſelf; it forms Figures which Imagination cannot conceive, it doubles Solids, it triples them, it increaſes and multiplies them *ad infinitum*, and infinitely beyond the force of Imagination. Nor do I believe that pure Intelligences can poſſeſs a more extenſive degree of Knowledge than that of Arithmetic, tho' they may penetrate its Subtilties more eaſily than we, and dive farther into its ſecret receſſes.

Arithmetic has this in particular, that you may find in each of its Operations that Perfection which is vainly ſought for in the whole Circle of the other Arts. No Palace, for inſtance, was ever ſeen ſo beautiful or regular, but another might be form'd, at leaſt in the Imagination, far beyond it, for Beauty and Regularity: No Picture or Statue, was ever ſo perfect, but a more perfect one might be conceived: No Harmony was ever ſo well concerted, but that we ſome-

times

times meet with what is ſtill more touching, and capable of giving a fuller Satisfaction to the Senſe we have of that Pleaſure: Yet this is no diſcouragement to the Study of Architecture, Painting, Sculpture and Muſic. We think our ſelves happy if we can attain to ſome reſemblance of thoſe who are Maſters in their way; and if we arrive to their pitch, we flatter our ſelves, that we have acquired a Reputation, which amply rewards all the Pains we have been at. Arithmetic is an Art more *Liberal* than all the reſt, for it makes *ready Payment* for our Diligence, in that it inſtantly gives the Demonſtration of its Operations, and ſets no Leſſon, which does not at the ſame time diſplay the perfection of its Secrets.

Laſtly, whatever beauty there is in Arithmetic, or any other of the Mathematical Sciences, it is certain, that thoſe who apply themſelves to ſuch Studies, always propoſe two Ends; one to underſtand things which raiſe and perfect the Mind, and the other to learn Rules, which tho' in themſelves abſtracted, yet are rendred very uſeful, when applied to any Subject. As it is true, that all who undertake the Study of Arithmetic, have ſome other ſenſible Object in view, as Trade and Commerce, Menſurations, and in ſhort, all things neceſſary to Civil Life, which have not an infinite Subject; ſo likewiſe it is true, that in reſpect to them, exact Computations may be made, and thus

Arirhmetic may be underſtood to perfection in regard to this ſecond and principal End propoſed, and its Rules advanc'd to the utmoſt degree of Exactneſs.

The ſame might be ſaid of Trigonometry, which is the ſecond Part of this Volume; *Plato* ſaid, that *Arithmetic and Trigonometry were the two Wings on which the Mind of Man mounted it ſelf to the Heavens.* I have taken care not to clip and ſeparate theſe two Wings, nor leave the Mathematician, whom I wou'd inſtruct, till I have made him capable of carrying his Eye up to the Heavens, to meaſure all the Motions there, and underſtand that Harmony, wherein conſiſt, according to the *Platoniſts*, the Joy and Happineſs of Beings ſeparated from Matter.

'Tis by Trigonometry only, that the Cauſes of the Phænomena's and Changes which happen in the Univerſe, can with any certainty, be diſcover'd; which Cauſes depend ſolely on the Figure and Motion of the World, and its Parts, nor can any one arrive at the Knowledge of the Motions of the Cœleſtial Bodies, but by that of the moſt ſimple Figures, which are Triangles, where Menſuration is taught by Trigonometry. By whoſe aſſiſtance Engineers meaſure acceſſible and inacceſſible Diſtances, and make their Levels for conveying Water. Geographers meaſure the Diſtances of Places ſituated on the Surface of the Earth; Aſtronomers, the Diſtances of Stars, whoſe Longitude

gitude and Latitude are known: The Art of Navigation depends entirely on Trigonometry: And in Dialling, Sun and Moon Dials are deſcrib'd on all ſorts of Planes with all poſſible exactneſs, the length of the Lines, and the quantity of the Angles, all by a Trigonometrical Computation: In Fortification it is exceeding uſeful, for the laying down of a Plan on the Ground, whoſe Draught is already deſcrib'd on Paper.

Laſtly, The Uſefulneſs of Trigonometry is ſo great, in all parts of the Mathematicks, that it is in a manner impoſſible to live without it, and the moſt important and uſeful parts of Knowledge wou'd be utterly loſt, if Mankind were ignorant of it.

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A

TREATISE

OF

Arithmetick.

SINCE *Arithmetick* is generally necessary in all the Parts of the *Mathematicks*, as also in all other Sciences, and almost in all Arts, because it makes up the principal Business of Mankind, who so usefully apply it to the Affairs of Civil Life; and since the Infallibility of its Principles, and the Evidence of its Demonstrations makes it to be esteem'd the chief Part of *Mathematicks*; it well deserves we shou'd here give it the precedence, and begin with the

DEFINITIONS.

I.

Arithmetick is a Science which has for its Object *Discreet Quantity*, that is to say, Numbers, considering the Properties thereof, teaching us to add them together, and this is call'd *Addition*; to substract a less Number from a greater, *Substraction*: To multiply them together, which is call'd *Multiplication*: And to divide them by one another, which is call'd *Division*: In a word, it is what teaches us the manner of making exact Computations.

Arithmetick is divided into *Speculative*, which considers Number and its Properties absolutely: And into *Practical*, which teaches the Use and Practice of Numbers, that is to say, how to perform readily all sorts of Calculations. This

therefore is what we intend to treat of in the following Discourse.

II.

Number is what expresses the Quantity, that is to say, the Multitude of several things of the same Kind: So that *to number* or *reckon* is to gather up several Units into one single Idea.

Number is divided into *Integers*, expressing one or more things of the same kind without any division, as two, three, *&c.* and into *Fractions*, representing part of the Unit, as a half, a third, *&c.*

III.

Unit is the least of whole Numbers, and by it we signify that a Thing considered in it self as indivisible, or not composed of parts, is *One*.

IV.

A *Figure* is the Character by which a Number is express'd. Since Numbers being innumerable, and each are different from the other, one would think that to represent them all, there ought to be many different Characters, which would cause great confusion to the Senses and Imagination, and wou'd load the Memory too much. But the Industry of Man has provided against this difficulty, by the admirable Invention which is found to represent all sorts of Numbers, by the means of only ten simple Figures, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, which we have borrowed from the *Arabians*, and are sufficient to represent all Numbers possible, as we shall shew, after having said that,

The first 0, which is call'd a *Cypher* signifies that which has no Quantity, and consequently signifies nothing; as for the others they signify something, and therefore they are call'd *significant Figures*: For there are few who do not know that the Second Figure 1, signifies *One*, that the third 2, signifies *two*, and so of the rest, as you see in the Table.

0. *Cypher*.
1. *One*.
2. *Two*.
3. *Three*.
4. *Four*.
5. *Five*.
6. *Six*.
7. *Seven*.
8. *Eight*.
9. *Nine*.

Tho'

Tho' the Cypher 0, signifies nothing in it self, yet it fails not to communicate to the significant Figures that preceed it, a Value ten times greater than that which it had before: So that being put after 1, which in it self is but one, it will make it ten times more, namely *Ten*, and being put after 2, which in its self is but two Units; it will make it two Tens, or *Twenty*, and so of the rest, as you see in the following Table.

10. *Ten.*
20. *Twenty.*
30. *Thirty.*
40. *Forty.*
50. *Fifty.*
60. *Sixty.*
70. *Seventy.*
80. *Eighty.*
90. *Ninety.*

In like manner the Cypher being put after 10, towards the right hand of the Writer, will make that 10, ten times more, that is to say, an *Hundred*, which consequently ought to be represented thus, 100: To which the Cypher being again added towards the right hand, will make the 100, ten times more, or ten Hundreds, which is call'd a *Thousand*, and consequently will be represented thus, 1000. So for the rest.

From whence it is easy to conclude, in a row of Figures written orderly in a right Line, from the left hand towards the right of the Writer or Reader, the first which is at the right hand shews simply nothing but the Units; and the second from the right to the left, shews as many Tens as there are Units; and the third shews as many Hundreds as there are Units, and so on in a Decimal Progression, as you see in the following Table,

Units,	*Thousands,*	*Millions,*
Tens,	*Tens of Thousands,*	*Tens of Millions,*
Hundreds,	*Hundreds of Thousands,*	*Hundreds of Millions.*

which shews that to find the Value of a Number compos'd of several Figures, which is called *Numeration*, as of this Number 872365412, these Figures must be separated into threes, by little Commas, beginning from the right hand towards the left, and applying in your mind, Units, to the first 2, of the three first Figures,

Eight Hundred,	*Seventy*	*Two Millions,*		*Three Hundred*	*Sixty*	*Five Thousand*		*Four Hundred,*	*Ten,*	*Two.*
8	7	2	,	3	6	5	,	4	1	2
Hundreds of Millions.	*Tens of Millions*	*Millions,*		*Hundreds of Thousands,*	*Tens of Thousands,*	*Thousands,*		*Hundreds,*	*Tens,*	*Units,*

Tens to the ſecond 1, and Hundreds to the third 4; then Thouſands to the firſt 5 of the three following Figures towards the left Hand, Tens of Thouſands to the ſecond 6, and Hundreds of Thouſands to the third 3 after that, Millions the firſt 2, of the three following Figures, Tens of Millions to the ſecond 7, and Hundreds of Millions to the third 8, &c. So that the propos'd Number 872, 365, 412. may be thus read, *Eight hundred, ſeventy two Millions, three hundred ſixty five thouſand, four hundred and twelve.*

V.

To Add ſeveral Numbers together, is to find one which equals all the others, and is call'd their *Sum.*

VI.

To Subſtract a leſs Number from a greater, is to find what remains of this greater, when the leſs is ſubſtracted; and that Remainder is call'd *Difference.*

VII.

To Multiply one Number by another, is to find a third, which the Mathematicians call *Product*, containing as many times the Multiplicand, as the Multiplicator contains Units.

It

It is evident that the more Units the Multiplicator contains, the oftner ſhall the Product contain the Multiplicand, and that the fewer Units the Multiplicator contains, the fewer times will the Product contain the Multiplicand: So that if the Multiplicator be a Fraction, or Part of an Unit, the Product will be leſs than the Multiplicand: And equal, if the Multiplicator be equal to an Unit.

VIII.

To Divide one Number by another, is to find a third, which is call'd *Quotient*, containing as many Units as the Number to be divided, which is called *Dividend*, contains the Number dividing, which is call'd *Diviſor*.

It is evident that the leſs the Diviſor is with reſpect to the Dividend, the greater is the Quotient, ſo that the Quotient will be equal to the Dividend, if the Diviſor be equal to an Unit, and greater if the Diviſor be leſs than an Unit.

IX.

The Square Root of a Number is a Number which being multiplied by it ſelf produces that Number whoſe Square Root it is ſaid to be, in reſpect of which Root this Product is call'd *Square*. Thus we find that 5 is the Square Root of 25, and 25 the Square of 5, becauſe 5 multiplied by it ſelf, that is to ſay, by 5, produces 25.

X.

The Cube Root of a Number is a Number, which multiplying its Square produces that whoſe Cube Root it is ſaid to be, in reſpect to which this Product is call'd *Cube*. Thus we find that the Cube Root of 125 is 5, becauſe 5 multiplying its Square 25, produces the Cube 125. It is evident that the Square, or the Cube of a whole Number is greater than its Root, and leſs when this Root is a Fraction.

PART I.

Of Whole Numbers.

WE shall discourse in this first Part concerning the four principal Rules of Arithmetick, namely, *Addition, Substraction, Multiplication, and Division,* which are the four Foundation Stones of this Science, because by their means all the other Operations are done, as the *Extraction of the Square and Cube Root,* which we will put immediately after these four principal Rules, which may properly be reduc'd to two, it being certain that Addition and Multiplication are one and the same thing, as well as Substraction and Division: For to multiply one Number by another, is no other thing than to Add that Number as many times as there are Units in the other; and to Divide by a Number, another greater Number, is to Substract this first Number as many times as is possible. Thus it may be said, that Multiplication is a compendious Addition, and Division a compendious Substraction.

We shall not stay long on the Demonstrations of all the Operations which we intend to teach in this first Part, because clearness and evidence accompany them throughout, at least in the four principal Rules, whose Certainty is discover'd in the Practice, especially when you have well comprehended *Euclid's Elements,* and what we have said in *Algebra* touching the Square and Cube Root.

PROBLEM I.

Single Addition.

SIngle Addition teaches the manner of adding together several things of the same kind, and of finding a *Sum* which is their equal, so that you may be assur'd not to be deceiv'd.

For this end, you must put the propos'd Numbers one under another, so that the Units may answer to the Units, the Tens to the Tens, the Hundreds (if there are any) to the Hundreds, and so on, leaving at a venture some Blank space towards the left hand; and having drawn a Line at the

the Bottom, as you ſee in the following Example, you muſt in this manner of reckoning which Nature and Uſe have taught you, add ſucceſſively and in order, all the Numbers which are in one and the ſame Column, beginning at the Place of Units, which is the firſt towards the right Hand, and write the Sum exactly under the Units, if it do not exceed 9, otherwiſe you muſt write only what ſhall be over and above the Tens, or 0, if there is nothing above the Tens, and retain as many Units as there are Tens, to be carried to the Tens of the following Column, towards the left Hand, the ſum of which being found in the ſame manner, you muſt write beneath what is above the Tens, and you muſt retain as many Units as there are Tens, which you muſt carry likewiſe to the following Column, by repeating the ſame thing till you have gone over all the Columns. It is evident that the Number which ſhall be found written under the Line, containing all the Figures of the Column of Units, all thoſe of the Column of Tens, and likewiſe all thoſe of the Column of Hundreds, and ſo of the reſt, will be the Sum of all the Numbers propos'd.

EXAMPLE.

To know how many Men an Army is compos'd of, where there are,

24326	*French* Infantry.
4235	*Swiſs* Infantry.
12035	Horſe.
6342	Dragoons.
2304	Gendarmes.
625	Cuiraſſiers.
49867	Men in all.
11120	Proof.

Having drawn a Line under the Numbers which you wou'd add together, as you ſee here, you muſt begin the Addition towards the right hand at the Column of Units, by ſaying 6 and 5 make 11, and 5 make 16, and 2 make 18, and 4 make 22, and 5 make 27, that is to ſay, 2 Tens, and 7 Units, wherefore you muſt write only 7 under the Column of Units, and for the 2 Tens you muſt carry 2, to be added to the following Column, which is that of

the Tens, being at liberty to begin the Addition of the Numbers of this Column at the top in going down, as we have done in the firſt, or at the bottom of the Column by going up, but it ſeems to me that 'tis beſt to begin at the Top, to be the more ready to put the Sum down at the bottom of the ſame Column under the Line. You muſt then go to the Tens, and ſay 2 Tens which you have carried, and 2 make 4, and 3 make 7, and 3 make 10, and 4 make 14, and 2 make 16, for the 0, ſignifying nothing, may be let alone. You muſt write the 6 under the Column of Tens, and you muſt carry one Ten, which being Ten times ten, that is to ſay, one Hundred, may be added to the following Column, which contains the Hundreds. If then you carry the Ten that you have retain'd to the following Column, which ought ever to be ſo done, for there muſt always be Ten Units of one Column to make one Unit of the following Column towards the left Hand; and you muſt uſe the ſame Method in this Column, and in the following one, as in the two firſt, you will have at the bottom of the Line this Sum 49867, which ſhews that an Army compos'd of all thoſe Troops, will be 49867 Men.

Proof of Single Addition.

Every Rule of Arithmetick is prov'd by its contrary, and conſequently Addition by Subſtraction; and tho' we have not taught Subſtraction, nevertheleſs ſince as much as needs be underſtood, for the Proof of Addition is naturally known to every one, we ſhall teach this Proof by Subſtraction, becauſe it is infallible, and carries its Demonſtration along with it, being founded upon this Principle, which teaches us, that if from a Whole, all its Parts be one after another taken away, there ought to remain nothing, that is to ſay, the Remainder ought to be 0.

To know then if the preceding Addition be good, or well done, that is to ſay, if the Number found 49867, be the true Sum of all thoſe which are under the Line, you muſt ſubſtract them from that Sum, beginning at the firſt Column towards the left Hand, and by ſaying 2 and 1 make 3, which I ſubſtract from 4 that is under the Line, and I write the remainder 1, under 4, this remainder 1, repreſenting the Ten that was carryed in the Addition, and conſequently making with the following Number 9, the Number 19. Entring in the ſame manner into the following Columns, I add all the Numbers of it, ſaying 4 and 4 make 8,

and

and 2 make 10, and 6 make 16, and 2 make 18, which being ſubſtracted from 19, there remains 1, which I write under 9. And thus one after another I repeat the ſame Operation in the following Columns toward the right hand, to the laſt, where there remains 0, which ſhews that the Addition of the Numbers propos'd is well done.

PROBLEM II.

Compound Addition.

Compound Addition teaches the manner of adding together ſeveral things of different Kinds. Altho' this Addition depends in ſome meaſure on Diviſion, which we have not yet taught, becauſe it often happens that one is oblig'd to réduce ſmall Species into larger ones, Pence into Shillings, and Shillings into Pounds, or Inches into Feet, and Feet into Yards, which cannot be done conveniently but by Diviſion; nevertheleſs ſince what muſt be known of it, is eaſy, by ſome contractions which naturally appear, we ſhall here explain in few Words what may be done in compound Addition.

Firſt then we muſt inform you, how many Units of one Denomination makes one of the next greater Denomination, and how many there muſt be of theſe to make again one of the next greater. Thus

1 LOUIS D'OR is 11 Livres *French.*
1 *Crown* 3 Livres.
1 *Livre* 20 Sols.
1 *Sol* 12 Deniers.
1 *Denier* 2 Oboli.
1 *Obolus* 2 Mites.
1 TOISE contains 6 Feet.
1 *Foot* 12 Inches.
1 *Inch* 12 Lines.
1 *Line* 12 ſenſible Points.
The ZODIAC 12 Signs.
1 *Sign* 30 Degrees.
1 *Degree* 60 Minutes.
1 *Minute* 60 Seconds.
1 YEAR 12 Months.
1 *Month* 30 Days.
1 *Day* 24 Hours.
1 *Hour* 60 Minutes.
1 *Minute* 60 Seconds.

1 POUND *Engliſh* is 20 Shillings.
1 *Shilling* 12 Pence.
1 *Penny* 4 Farthings.
1 MILE *Engliſh* is 8 Furlongs.
1 *Furlong* 40 Poles or Perches.
1 *Pole* $5\frac{1}{2}$ Yards.
1 *Fathom* 6 Feet.
1 *Yard* 3 Feet.
1 *Ell* $1\frac{1}{4}$ Yard.
1 *Foot* 12 Inches.
1 *Inch* 3 Barley-Corns.

1 QUIN-

1 QUINTAL *Paris* is 100 lb. weight.
1 *Pound* 2 Marcs.
1 *Marc* 8 Ounces.
1 *Ounce* 8 Drams.
1 *Dram* 3 Deniers.
1 *Denier* 2 Mailles.
1 *Maille* 12 Grains.
1 *Grain* 24 Primes.
1 *Prime* 24 Minutes.
1 *Minute* 24 Puilles.
1 MUID *of Wine Paris* is 3 Feuillettes.
1 *Feuillette* 12½ Septiers.
1 *Septier* 4 Quarts.
1 *Quart* 2 Pints.
1 *Pint* 2 Chopines.
1 *Chopine* 2 Demiſeptiers.
1 *Demiſeptier* 2 Poſſons.
1 *Poſſon* 2 Pouceons.
1 *Pouceon* a Cubic Inch.
1 MUID *of Corn, Paris* is 12 Septiers.
1 *Septiers* 2 Mines.
1 *Mine* 2 Minots.
1 *Minot* 3 Buſhels.
1 *Buſhel* 16 Litrons.
1 *Litron* 36 Cubic Inches.

1 TUN *Engliſh* is 20 Hundred weight.
1 *Hundred* 112 Pounds.
1 *Pound* 16 Ounces.
1 *Ounce* 8 Drams.
1 *Dram* 3 Scruples.
1 TUN of Wine *London* is 2 Pipes.
1 *Pipe* or *Butt* 2 Hogſheads.
1 *Hogſhead* 63 Gallons.
1 *Barrel of Beer* 34 Gallons.
1 *Gallon* 4 Quarts.
1 *Quart* 2 Pints.
1 *Pint* 1 lb. of Wheat *Troy* weight.
1 LAST *Engliſh* is 10 Quarters.
1 *Quarter* 8 Buſhels.
1 *Buſhel* 4 Pecks.

This being ſuppos'd, write all the Sums propos'd one under another, ſo that the Species which are alike may be in one and the ſame Column, as you ſee in the following Example, which is an Addition of Pounds, Shillings and Pence, and begin to add together the leaſt Kinds which are in the firſt Column towards the right hand, as here the Pence, and after having ſeen how many Shillings they make, put

Pounds.	*Shillings.*	*Pence.*	
1259	13	4	
6724	9	6	
83702	15	11	
1543	5	2	
93230	3	11	Sum.
12122	1	0	Proof.

the

the overplus underneath the Column of Pence, and carry the Shillings to be added to the Column of the Units of the Shillings, of which you muſt make a Sum, and after having examin'd how many Pounds this Sum of Shillings make, you muſt write the overplus under the Column of Shillings, and you muſt carry the Pounds to the Column of Pounds, and the reſt of the work will be as in the preceding Problem.

In the propos'd Example, becauſe the Sum of the Pence is 23, which makes one Shillings and 11 Pence, I write 11 Pence under their Column, and I retain one Shilling, which I carry to its Column, the Sum of which is 43 Shillings, which make 2 Pounds and 3 Shillings, wherefore I write 3 under the Column of Shillings, and I retain 2 Pounds, which I carry to the Columns of Pounds, and finiſh the reſt as in the preceding Problem.

The Proof of Compound Addition.

The Proof of this Addition is much the ſame with that of Single Addition, namely by ſubſtracting from the general Sum all the particular Sums, of which it is compos'd; becauſe if the Addition be well done, there ought nothing to remain, as you have already ſeen in the preceding Problem, and as you ſhall ſee again here.

Firſt, I begin at the left Hand in the firſt Column of Pounds, by ſubſtracting 8 from 9, and by putting the Remainder 1, at the Bottom of the ſame Column under 9.

Secondly, I find that the following Column make 11, which I ſubſtract from 13 that is under it, and I put the 2 that remains under 3, and I continue thus to the laſt Column of Pounds, where there remains 2 Pounds, which with the three Shillings that follow, make 2 Pounds and 3 Shillings.

Thirdly, I find at the Column of Shillings, 42 Shillings, which make 2 Pounds and 2 Shillings, which being ſubſtracted from 2 Pounds and 3 Shillings, and there remains 1 Shilling, which I put under 3, and with the 11 Pence following make 1 Shilling and 11 Pence, or in all 23 Pence.

Laſtly, The Column of Pence makes 23 Pence, which being ſubſtracted from the 23 Pence that remain at the Bottom, there remains nothing, which ſhews the Addition is good.

SCHO-

SCHOLIUM.

When the Sum of the *Pence* happens to be great, it will be hard without Division to know the Number of Shillings therein. To avoid this difficulty, you must in adding together the Numbers of the Column of Pence substract 12 for a Shilling, and mark a little Stroke by the last Number which you shall have added, to remember you that you are to retain a Shilling: Then you must continue the Addition by adding the overplus of the Pence, which remain'd after Substraction to the following Numbers, until you have another Sum which exceeds 12, in which Case you must take away 12 from it, for another Shilling, which must be retain'd, by marking in like manner, a Stroke to remember you of it, and so on, and the Number of the mark'd Strokes will shew that you must carry as many Shillings, and add them to the Column of Shillings, as hath been taught. You must do the same thing for the other Kinds, as you see in the following Example, which may be comprehended at sight.

Toises.	*Feet.*	*Inches.*	*Lines.*	
625	4	9	10	
1235	3	8	8	
641	5	11	9	
324	2	7	7	
3242	4	9	6	
832	1	10	5	
6902	5	9	9	Sum.
2223	4	3	0	Proof.

It often happens that you are to add a great multitude of Numbers, and then not to confound your self, and so be oblig'd to go over the Work several times, you must make diverse Partitions of it from 5 to 5, or from 10 to 10, that you may re-unite each into one Sum, and adding all these Sums into one, you will have the Sum of the Numbers proposed: Or you must add together the five first, and you must write under their Sum the following five, and add them to the preceding Sum, and so on to the last Sum, which will be that which was requir'd. You will find an Example of it in the second Table, which we have

have added to our *Practical Geometry*, to expreſs in Numbers the Circumference of a Circle, by its given Diameter.

PROBLEM III.

Single Subſtraction.

Single Subſtraction teaches the manner of ſubſtracting one Number from a greater of the ſame kind, to know their *Difference*, which is alſo call'd *Remainder.*

For this end, having written the leaſt of the two propos'd Numbers under the greater, ſo that the Units, the Tens, the Hundreds, &c. be under the Units, the Tens, the Hundreds, &c. and having drawn a Line at the Bottom, as in the two preceding Problems, ſubſtract each Figure below from that which is ſuperior to it, beginning from the right Hand to the left, and write at each Time the Remainder under the Line, ſo that you muſt write there an 0, if there remains nothing. That being done, it is evident that the Number repreſented by theſe laſt Figures, which will be found under the Line, will be the Difference or Remainder requir'd.

EXAMPLE.

The veſting of a Ravelin coſt an Undertaker 4876 *l.* of which he had receiv'd 3254 *l.* and he wou'd know how much was yet due to him, which will be found by ſubſtracting the Sum that was paid him from what he had expended, that is to ſay, by ſubſtracting 3254 from 4876, thus.

Having diſpos'd the Sum which the Undertaker receiv'd under the Sum which he had expended, as you ſee in this Example, and having drawn a Line at the Bottom.

4876	Expended.
3254	Paid.
1622	Remainder.
4876	Proof.

I begin with the Units at the right hand, and I ſay, I ſubſtract 4 from 6, or ſimply 4 from 6, there remains 2, which I put under the 4; then coming to the Tens, I ſay 5 from

7, there

7, there remains 2, which I write under the 5; after that, coming to the Hundreds, I ſay 2 from 8, there remains 6, which I put under 2; and laſtly coming to the Thouſands, I ſay, 3 from 4, there remains 1, which I put under 3; ſo that there will be yet due to the Undertaker 1622 *l.* as will be eaſily known by Addition, it being certain that if you add the two laſt Numbers together, namely the Remainder 1622, and what was paid 3254, the Sum ought to be equal to the Expence 4876.

You ſee by this Example, that Subſtraction is not hard, when each Figure at the Top is greater than each of thoſe which are at the Bottom, It is not quite ſo eaſy when ſome of the Bottom Figures are greater than thoſe at the Top. In this Caſe there is nothing to do but to borrow one Ten from the next Figure, at the Top towards the left Hand, and add it to the leſs at the Top, to the end that from this Number ſo augmenred by 10, you may ſubſtract the Number at the Bottom; and then the Figure at the Top, from which you have borrowed a Ten, is leſs by a Unit, or without diminiſhing this Figure it is better to augment by an Unit the Figure at the Bottom, and ſubſtract this Figure ſo augmented from the Units of the ſuperior Figure which anſwers it, by borrowing in like manner a ten from the neareſt Figure towards the left hand, in caſe that the Subſtraction be impoſſible. This will be better comprehended by the following Example.

A Ship is to make a Voyage of 3423 Leagues; and it has made 318 of 'em; the Queſtion is, how many it has yet to make of them, which will be known by ſubſtracting 318 from 3423 thus.

Having written the leaſt Sum, which you would ſubſtract, under the greater, as has been ſaid, and as you ſee in the following Example,

3423	Principal Sum.
318	Sum to be ſubſtracted.
3105	Remainder.
3423	Proof.

and having drawn a Line under theſe two Numbers, I ſay, 8 from 3, I cannot, I borrow 1 from the 2 next towards the left hand, and as this 2 is in the Column of Tens, the Unit which I borrow above is 10, which with the 3 makes 13, from

13, from which I ſubſtract the 8, at the Bottom, and I put down the Remainder 5; after which I carry 1, which I add to the following Figure at the Bottom, which is alſo 1, and I have 2, which I ſubſtract from the Figure 2 at the Top, and as there remains nothing, I put 0 below under 1; after that I come to the third Figure, ſaying, 3 from 4 there remains 1, which I write under 3, and becauſe under the 3 at the Top there is nothing written which may be ſubſtracted, I write this 3 underneath. Thus you have 3105 Leagues that the Ship has to ſail.

SCHOLIUM.

When there are Cyphers in the Figures above, it is ſufficient to borrow 10, that you may be able to ſubſtract (if the Figure below be ſignificant) for if it is alſo a Cypher, it will not be neceſſary to borrow any thing, and it will be ſufficient to put a Cypher underneath the two Cyphers, becauſe in ſubſtracting nothing from nothing, there remains nothing; and when you are to ſubſtract a Cypher from a ſignificant Figure, you muſt put ſimply that ſignificant Figure underneath the Cypher; ſee the following Example.

EXAMPLE.

A King has an Army of 31200 Men, and he will diſband 10160. He wou'd know how many there remains of them, which may be done by ſubſtracting 10160 from 31200, thus.

Having written the leaſt Sum, which you would ſubſtract under the greater, as uſual, and as you ſee here, and having drawn a Line.

31200	Principal Sum,
10160	Sum to be ſubſtracted.
21040	Remainder.
31200	Proof.

under theſe 2 Numbers, I ſay 0 from 0, there remains 0, which I write under the 0; then I ſay, 6 from 0 I cannot, wherefore I borrow 10, ſaying 6 from 10, there remains 4, which I write below under the 6, and I carry 1, which with 1 that follows, makes 2, and being ſubſtracted from 2 there remains 0, which I write below under 1; I ſay after-

afterwards, o from 1, there remains 1, which I put below under 6; and lastly, I say 1 from 3, there remains 2, which I put below under 1, and the Remainder will be 21040 Men.

When you are to substract several Sums from one single one, you may substract from this single Sum one of the Sums to be substracted, and from the Remainder one of the other Sums to be substracted, and continue thus untill all the Sums have been substracted, or you may add separately all the Sums to be substracted, and substract their Sum from the propos'd Sum. But it will be yet sooner done, by writing all the Sums to be substracted one under another below that out of which you wou'd substract, and subduct from this Sum all the Sums to be substracted at the same time, as you shall have added them together, by borrowing as many Tens as is necessary. The following Example will clear all this.

EXAMPLE.

A Nobleman has 6542 *l.* 1543 of which he has spent in Horses, 2304 in Cloaths, and 1648 in Arms. The Question is how many Pounds he has left, which may be known by substracting 1543, 2304, and 1648 from 6542 thus.

6542 Principal Sum.

$$\left.\begin{array}{r}1543\\2304\\1648\end{array}\right\}\text{ Sums to be substracted.}$$

1047 Remainder.

Having dispos'd all these Numbers, as you see here, I say 8 and 4 make 12, and 3 make 15, which I cannot substract from 2, wherefore I substract them from 22, by borrowing 2 Tens, because so many must be borrow'd, that a Substraction may be made, and write the Remainder 7 below under 8, and because I had borrow'd 2 Tens, I carry 2 which I add to the following Column, saying 2 and 4 make 6, and 4 make 10, which cannot be substracted from 4, wherefore I say, 10 from 14, there remains 4, which I write below under 4, and for the Ten borrow'd, I carry 1, then I say, 1 and 6 make 7, and 3 makes 10, and 5 makes 15, which cannot be substracted from 5, wherefore I substract 'em from 15, by borrowing 1 Ten, and as there remains nothing, I put o below under 6; and

6; and laſtly I ſay 1 and 1 make 2, and 2 make 4, and 1 make 5, which being ſubſtracted from 6, there remains 1, which I write below under 1. So that the Remainder will be 1047. The Proof of which will be done by adding this Remainder to the three Sums to be ſubſtracted, becauſe the Sum above ought to be found.

When you are to Subſtract one Number from ſeveral others, you muſt add together all theſe other Numbers, and ſubſtract from their Sum the propos'd Number, as you ſhall ſee in the following

EXAMPLE.

An Officer is to take 14326 Men out of four Regiments, the firſt of which contains 4325 Men, the ſecond 4212, the third 3876, and the fourth 3957. The Queſtion is, how many Men there remains of all theſe Regiments, which will be known thus.

$$\left.\begin{array}{r}4325\\4212\\3876\\3957\end{array}\right\}\text{ Men.}$$

$$\begin{array}{rl}\hline 16370 & \text{Sum.}\\ 14326 & \text{Men to be rais'd.}\\ \hline 2044 & \text{Remainder.}\end{array}$$

The Sum of the four Regiments is 16370, from which if you ſubſtract the 14326 which was to be rais'd, there will remain 2044.

Laſtly, when you are to ſubſtract ſeveral Numbers from ſeveral others, it is evident that there needs no more than to ſubſtract the Sum of the firſt from the Sum of the laſt. But that may be done at one ſingle Operation, by a particular Method that has its Demonſtration, which we do not put here, that you may have the Pleaſure of finding it your ſelf, becauſe it is eaſy.

To ſubſtract then from the Numbers A, for Example, all the Numbers B, ſay 3 and 3 is 6, and 3 is 9, which being ſubſtracted from the next Ten, which is 10, there remains 1, which you muſt carry, and add it to the correſponding Numbers of the Column A, by ſaying 1 and 2 is 3, and 8 is 11, and 3 is 15, and 4 is 18: put 8 underneath; and becauſe you have found here a Ten as in the Column B, I retain nothing, and I begin to reckon in the ſame manner in the following Column, ſaying 4 and 4 is 8, and

2 is 10, which being ſubſtracted from the next Ten, which is alſo 10, there remains nothing, wherefore continuing to add above, I ſay 1 and 8 is 9, and 4 is 13, and 8 is 21,

49684	
27843	A
32188	
146412	
31823	
41543	B
52343	
130418	Remainder.
256127	Proof.

put 1 underneath, and becauſe there are two Tens here, and below you have found but one of 'em, I carry the difference of theſe Tens, that is 1, which I ſubſtract below from the following Column, becauſe I found more Tens above than below, for this difference muſt have been added, if you had found more Tens below than above. I ſay then 1 from 3 there remains 2, and 5 is 7, and 8 is 15, which being ſubſtracted from the next Tens, which is 20, there remains 5, and I ſay 5 and 4 is 9, and 1 is 10, and 8 is 18, and 6 is 24, wherefore I put 4 underneath, and carry nothing, becauſe there are as many Tens here above as below, namely, 2. Being come to the next Column, I ſay 2 and 1 is 3, and 1 is 4, which being ſubſtracted from the next Ten, which is 10, there remains 6, and I ſay 6 and 6 is 12, and 2 is 14, and 7 is 21, and 9 is 30, I write the 0 underneath, and carry 2, becauſe there are two Tens above more than below, which I ſubſtract for that Reaſon, from that below, ſaying in the following Column, 2 from 5 there remains 3, and 4 make 7, and 3 make 10, which being ſubſtracted from the next Ten, which is alſo 10, there remains nothing, wherefore I carry nothing, and I continue the Operation above, ſaying 4 and 3 make 7, and 2 make 9, and 4 make 13, and I write 3 below, without carrying any thing, becauſe I found as many Tens above as below. Laſtly, ſet down below the 1 which remain'd above in the laſt Column, becauſe there is nothing left below, ſo that the Remainder will be 130418, as will appear by adding this Remainder to the Numbers B, for the Sum ought to be equall to thoſe of the Numbers A.

PROB-

PROBLEM IV.

Compound Substraction.

Compound Substraction teaches to substract a Sum compos'd of several different kinds, from another greater Sum compos'd of the same kinds as the preceding ones, to find their Difference.

For this end having written the least Sum under the greater, so that those of the same Name answer one under another, and having drawn a right Line underneath, as you see in the following Example; begin at the first Column of those of the least Denomination which are at the right hand, and substract these below from those above, and in case Substraction cannot be made, which happens when the Number below exceeds that of the same kind above, then borrow a Unit of the next greater Denomination towards the left hand, and make it go for its value in that Place, according to the Nature of the several Denominations, which you ought to know; then you must carry 1, and add it to the next Figure below of the next Column towards the left hand; and thus you must go on with the rest, by a reasoning as before, and by a Method altogether like that in the last Problem.

EXAMPLE.

One Merchant ow'd to another the Sum of 343 *l.* 12 *s.* and 4 *d.* of which he hath given him 46 *l.* 18 *s.* 6 *d.* The Question is how much he owes him yet, which will be found by Substraction thus.

l.	*s.*	*d.*	
343	12	4	*Principal Sum.*
46	18	6	*Sum paid.*
296	13	10	*Remainder.*
343	12	4	*Proof.*

Having put down the least of the two propos'd Sums under the greater, as you see here, and having drawn a Line, underneath as usual, begin to substract 6 *d.* from 4 *d.* which I cannot, I borrow, 1 *s.* or 12 *d* which with 4 *d.* make 16 *d.* from whence substracting 6 *d.* there remains 10 *d.* this I put under the Pence. Afterwards I augment 8 by 1, which is the Unit that I borrow'd, and I say 9 from 2, or rather 19 from 12, I cannot, I borrow 1 *l.* or 20 *s.*

 which

which with 12 *s.* make 32 *s.* I say then 19 from 32 there remains 13, which I write under the Shillings. Afterwards being willing to substract 7, (which is the 6 augmented by the Unit that I borrow'd from 3, I cannot, I borrow 1, that is 10, which consequently with 3 will make 13, from whence substracting 7, there remains 6, which I write again underneath. Thus continuing the Operation as hath been taught in the preceding Problem, you will find that the Remainder will be 296 *l.* 13 *s.* 10 *d.*

You must work in the same manner when you have other Denominations, as you will see in this other

EXAMPLE.

To find on the 24th of *March* the Year 1691. at two of the Clock in the Afternoon, at which time we writ these Lines. the Age of a Person, who was born in the Year 1640, the 6th Day of *May*, at 4 of the Clock in the Morning. You must reckon but 1690 Years compleat, 2

	Years.	*Months.*	*Days.*	*Hours.*
From	1690	2	23	14.
Substract	1639	4	5	4
Remain	50	10	18	10

Months ended, 23 Days compleat, and 14 Hours, because the Year 1691 is not yet ended, and the Day begins at Midnight, and also 1639 Years compleat, 4 Months ended, 5 Days compleat, and 4 Hours, for the same Reason, and substract this Sum from the First, and the Remainder will give 50 Years, 10 Months, 18 Days, and 10 Hours, for the Age requir'd.

When in the greater Sum there wants Terms of the same name with those in the Sum which you would substract, you must put a Cypher in the place of what is wanting, after that the Operation will be as before, and as you see in the following

EXAMPLE.

The Line of Defence of a Polygon is 120 Fathoms, and its part terminated by the Curtain and the Flank, is 79 Fathoms, 3 Feet, 8 Inches, 2 Lines. The Front of the Bastion is requir'd: Which may be found by Substraction,

Fathoms.	*Feet.*	*Inches.*	*Lines.*	
120	0	0	0	*Line of Defence.*
79	3	8	2	*Part to be substracted.*
40	2	3	10	*Front of the Bastion.*

as

as you fee here, where the Remainder 40 Fathoms, 2 Feet, 3 Inches, and 10 Lines, is the Front of the Baftion.

Laftly, when from one Sum you are to fubftract feveral others, you muft write them under this Sum, and finifh the reft as has been taught in the preceding Problem, and as you fee in this

EXAMPLE.

The interior fide of an irregular Polygon is 130 Toifes, one of the two Demigorges is 24 Toifes, 2 Feet, 4 Inches, and 3 Lines, and the other Demigorge is 26 Toifes, 5 Feet, 2 Inches, and 5 Lines. The Length of the Curtain is requir'd,

Toifes.	*Feet.*	*Inches.*	*Lines.*	
130	0	0	0	*Interior Side.*
24	2	4	3	*Demigorge.*
26	5	2	5	*Demigorge.*
78	4	5	4	*Curtain.*

which is found by Subftraction, as you fee here, where the Remainder 78 Toifes, 4 Feet, 5 Inches, and 4 Lines, is the Length of the Curtain.

PROBLEM V.

Single Multiplication.

Single Multiplication teaches the manner of multiplying together two given Numbers of the fame kind, which hereafter we will call *abfolute Numbers*, whereby to find their *Product*; which is call'd *a Square Number*, when 'tis produc'd by the Multiplication of two equal Numbers; and a *Cubic Number*, when it is produc'd by the continual Multiplication of three equal Numbers; and laftly *a Plane Number*, when the two Numbers which are multiplied are unequal.

That of thefe two Numbers which multiplies the other, is commonly call'd *Multiplicator*, and the other which is multiplied is call'd *Multiplicand*. It is indifferent which you take of thefe two for the Multiplicator, becaufe the Product will be always the fame, as we have remark'd in the firft Definition of the fecond Book of *Euclid*'s Elements. Yet commonly the leaft Number is taken for the Multiplicator, becaufe it is eafier to multiply a greater Number by a lefs, than to Multiply a lefs by a greater.

To

To Multiply great Numbers, you must of Necessity know by heart the Product of these lesser ones, that is to say of the nine Digits or first Figures, from 1 to 9 inclusive; which those who have never so little of the Practice of Accompts, can hardly be ignorant of; Nevertheless for the Ease of young Persons, we have here added the following *Table of Multiplication*, which is said to have been invented by *Pythagoras*, its Use is,

1	2	3	4	5	6	7	8	9
2	4	6	8	10	12	14	16	18
3	6	9	12	15	18	21	24	27
4	8	12	16	20	24	28	32	36
5	10	15	20	25	30	35	40	45
6	12	18	24	30	36	42	48	54
7	14	21	28	35	42	49	56	63
8	16	24	32	40	48	56	64	72
9	18	27	36	45	54	63	72	81

To find the Product, for Example, of these two simple Numbers 5 and 8, you need only look for one of these two Numbers, as 5 in the first Column towards the left hand, and look for the other Number 8, in the first Column at the Top, and then, under 8 and over against 5, the two given Numbers, you will give a third Number 40, for the Product.

In like manner, if you wou'd know how many 8 times 9 make, or 9 times 8, you must take, for Example, 8 in the first Column, towards the left hand, and 9 in the first Column at the top, and you will find under this 9, and opposite to 8, the Product 72, of those two Numbers 8, 9. So of the rest.

This being supposed, write the Multiplicator under the Multiplicand, according to the Method given in the preceding Problems; and having drawn a Line underneath, multiply by the first Figure of the Multiplicator towards the right hand, each Figure one after another of the Multiplicand, beginning in like manner at the first Figure towards the right hand, and as often set down in order, from the right to the left, the Product arising under the Line, provided it doth not exceed 9, for if the Product be express'd by two Figures, as it often happens, put down only the last, and carry the first to be added to the Product, which you will have by the following Multiplication. You must Multiply in the same manner the Multiplicand by the other Figures of the Multiplicator, observing that if you multiply by a

Ten

a Ten, you must begin to write the Product under the Tens, and if you multiply by a Hundred, the first Figure of the Product must be under the Hundreds, and so on towards the left Hand. Lastly having drawn a Line under the last Product, add together all the Products, included between the two Lines, and the Sum will be the Product requir'd, as is evident *by* 1. 2.

EXAMPLE.

A Prince spends 3456 *l.* a Day, and wou'd know how much he spends in a Year, which is found by multiplying what he spends a Day, which is 3456 *l.* by 365, which is the Number of Days in a common Year thus. After having put the Multiplicator under the Multiplicand, as you see here, and drawn a Line underneath, say to your self in this manner 5 times 6 is 30, put down 0, and carry 3; 5 times 5 is 25, and 3 which I carried is 28, I put down 8, and carry 2; 5 times 4 is 20, and 2 which I carried is 22, I put

```
   3456 Multiplicand.
    365 Multiplicator.
  -----
  17280
 20736
10368
-------
1261440 Product.
```

down 2, and carry 2; 5 times 3 is 15, and 2 which I carried, is 17, I put down 7, and next to it 1, because I have multiplied all. Then I proceed to multiply the same Numbers by 6, which represents 6 Tens, say 6 times 6 is 36, I put 6 under the Tens, and I carry 3; 6 times 5 is 30, and 3 which I carried is 33, I put down 3, and I carry 3; 6 times 4 is 24, and 3 which I carried is 27, I put down 7, and I carry 2; 6 times 3 is 18, and 2 that I carried is 20, which I write down.

Lastly, coming to the last Figure 3, which represents three Hundreds, say 3 times 6 is 18, I put 8 under the Hundreds, and I carry 1; 3 times 5 is 15, and 1 which I carried is 16, I put down 6, and carry 1; 3 times 4 is 12, and 1 which I carried is 13, I put down 3, and carry 1; 3 times 3 is 9, and 1 which I carried is 10, I put down 10.

Lastly, add together the three Products, 17280 20736, 10368, which are equal to these three, 17280, 207360, 1036800, the Cyphers being understood to be in the Blank places towards the right hand, because the Multiplication

was done by Tens; which have a Cypher, and by Hundreds, which have 2 Cyphers, and you will have in the Sum 1261440 *l.* for the Product requir'd, or for the Expence of a whole Year. The Proof of which may be done by Division, namely by dividing the Product by one of the Numbers which was multiplied; because the other Number ought to be found: For it is evident that Division, which is contrary to Multiplication, undoes what that doth.

SCHOLIUM.

Since a Cypher in multiplying produces nothing, if in the Multiplicator there be any Cyphers intermix'd, let them not be meddled with, but multiply the Multiplicand by the other significant Figures of the Multiplicator, and for fear of placing the particular Products wrong, it will not be amiss to put a Cypher under that which is in the Multiplicator, as you see in this

EXAMPLE.

The Contents of a Piece of Ground is requir'd, which hath the Figure of a Oblong, whose Length is for example, 324 Perches, and the Breadth 208. This may be done by multiplying the Length by the Breadth thus.

```
  324 Length.
  208 Breadth.
 -----
 2592
6480
------
67392 Contents.
```

Having put the breadth under the length, as you see here, and multiplied 324 by 8, put a Cypher under the 9, below the same 0, in the Multiplicator, after that multiply 324 by 2, and the two Products being added together, will give 67392 Square Perches for the Content requir'd.

When the Multiplicator contains some Cyphers, towards the right hand, you must in like manner, put a Cypher down below that Cypher, and then multiply by the other significant Figures of the Multiplicator; and for the more Ease in Practice, it will not be amiss to place the first Figure of the Multiplicator towards the right hand, under the first Figure of the Multiplicand, as if there was no Cypher, and as you see in this

EXAM-

EXAMPLE.

It is requir'd how many Pence there are in 625 Crowns, a Crown containing 60 Pence. It is evident that in 625 Crowns, there will be 625 times 60 Pence, and consequently there needs no more than to multiply 625 by 60, and the Product shews that in 625 Crowns, there are 37500 Pence.

625 *Sum of the Crowns.*
60 *Value of a Crown.*

37500 *Number of the Pence.*

If in the Multiplicand and the Multiplicator there are Cyphers on the right hand, you may neglect those Cyphers, to avoid the Confusion that many may cause, and after having multiplied all the significant Figures, you must add all those Cyphers which had been neglected, to the right hand of the Product, as you see in this

EXAMPLE.

To find how much 7800 Yards of Brick-work will cost, at the rate of 50 *d.* the Yard; you must multiply 78 by 5, and then add the three Cyphers, which were neglected, to the Product 390, and you will have 390000 for the Price of 7800 Cubic Yards.

78 *Multiplicand.*
5 *Multiplicator.*

390. 000 *Product.*

Since the particular Products in multiplying gains room towards the left hand, if on that Side there is not Space enough to put the Figures down in their Order, which may often happen, as in proving Division by Multiplication; in such a Case it will not be amiss to place the Multiplicator otherwise, by putting the first Figure thereof towards the left hand, under the first of the Multiplicand towards the right, so that the other Figures of the Multiplicator, may advance towards the right hand: After this, you must begin to multiply at the first Figure towards the left hand of the Multiplicator, then at the rest towards the right, and so on, as in the following

EXAM-

EXAMPLE.

To find how many Hours in a Biſſextile Year, which contains 366 Natural Days; you muſt multiply 366 by 24, which the number of Hours in a natural Day, thus,

```
 366
  24
────
 732
1464
────
8784 Product.
```

Having put the Multiplicator 24 under the Multiplicand 366, as before directed, and as you ſee here, I begin to multiply by 2, and write the Product 732 underneath, ſo that the firſt Figure 2, at the right hand anſwers to the Figure 2 which multiplies: I multiply afterwards by the next Figure 4, putting the Product 1464 underneath, ſo that in like manner the firſt Figure 4 towards the right hand anſwers the Figure 4, which multiplies. Laſtly, I add together the two Products, and the Sum 8784, will be the Product ſought, or the number of Hours in 366 Natural Days.

Compendiums in Multiplication.

Since Multiplication is of great Uſe in all ſorts of Accompts, and the Practice of it laborious, when the Numbers to be multiplied are ſomething great, one may diſpatch more Buſineſs, and ſave time by making uſe of Compendiums, when they can be met with. Theſe Compendiums will be eaſily found by him that underſtands the Properties of Numbers, which are almoſt all naturally known to every one : Wherefore I ſhall content my ſelf only to give here ſome Examples of Compendiums, which may be drawn from thence.

1. The Property of Unity being ſuch, that by multiplying it doth not augment the Product, and of a Cypher that in multiplying it produces 0, it follows that the readieſt way to multiply a propos'd Number by 10, by 100, by 1000, or by any other Number compos'd of Unity, and as many Cyphers as you pleaſe, there needs no more but to put all the Cyphers at the right hand of the given Number, and you will have the Product. Thus 324 Ells of Stuff, at 10 Shillings an Ell are worth 3240 Shillings, and in like manner 32 *French* Piſtoles are worth 320 Livres, becauſe a *French* Piſtole is valued at 10 Livres. It appears alſo in the

the ſame manner, that 56 Acres of Land, at 100 Pence the Acre, are worth 5600 Pence. So of the reſt.

2. By this ſame Property of the Unit, it is plain that to multiply a given Number by 11, there is nothing to do but to write the ſame Number down, the one a Place further towards the left hand, than the other, and add together theſe two Numbers ſo diſpos'd, their Sum will be the Product requir'd. Thus to find how many Livres 56 Louis D'ors make, at 11 Livres the Louis D'or, you muſt write 56 under 56, as you ſee here, and the Sum of theſe two Numbers will ſhew, that in 56 Louis D'ors there are 616 Livres.

$$\begin{array}{r} 56 \\ 56 \\ \hline 616 \end{array}$$

3. From whence it follows, that to multiply a given Number by 12, which is greater by an Unit than 11, it muſt be written once directly under it ſelf by reaſon of this Unit, and once again a Place farther towards the left hand, and add theſe three Numbers together. Thus to find how many Inches there are in 32 Feet, you muſt write this Number 32, as you ſee here, and the Sum 384 will be the Number of Inches contain'd in 32 Feet. But that may be done otherwiſe, and more eaſily, as you ſhall ſee.

$$\begin{array}{r} 32 \\ 32 \\ 32 \\ \hline 384 \end{array}$$

4. You may, without making any Addition, multiply a propos'd Number by another, when this other Number ſhall be produc'd by the Multiplication of two other leſs Numbers, which we will call *producing Numbers*, which elſewhere we call'd *Sides*, becauſe the Multiplicator by this Suppoſition, is a plain Number, whoſe two producing Numbers are its Sides; namely by multiplying the given Number by one of the two producing Numbers, and the Product by the other producing Number: For the Second Product will be that which is requir'd.

Thus to know how many Pence there are in 24 Shillings, it is known that you muſt multiply 24 by 12, becauſe there are 12 Pence in a Shilling; then as 12 hath theſe two producing Numbers, 3, 4, you muſt multiply 24 by 3, and the Product 72

$$\begin{array}{r} 24 \text{ *Shillings.*} \\ 3 \\ \hline 72 \\ 4 \\ \hline 288 \text{ *Pence.*} \end{array} \qquad \begin{array}{r} 24 \text{ *Shillings.*} \\ 2 \\ \hline 48 \\ 6 \\ \hline 288 \text{ *Pence.*} \end{array}$$

by

by 4, and this ſecond Product 288 will be that which is requir'd; becauſe the Quadruple of a Triple is the Dodecuple; and becauſe Sextuple of a Double is alſo Dodecuple, it is plain that ſince 12 has theſe two other producing Numbers, 2, 6, you may alſo multiply the given Number 24 by 2, and the Product 48 by 6, and you'l have the ſame Product 288 for the Number of Pence in 24 Shillings.

5. You may upon this Principle, reduce by way of a Compendium all ſorts of higher Denominations into lower; as to reduce 42 Pounds into Pence, you muſt multiply them by 20, for the Shillings, which you muſt Multiply by 12, that is to ſay by 3 and 4, to have the Pence. In like manner to find how many Inches there are in 43 Fathoms, you muſt multiply 'em by 6 to have the Feet, and theſe Feet by 12, or by 3 and 4, for the Inches.

42	*Pounds.*	43	*Fathom.*
20		6	
840	*Shillings.*	258	*Feet.*
3		3	
2520		774	
4		4	
10080	*Pence.*	3096	Inches.

6. It is evident alſo, by the ſame Principle, that to multiply a given Number by a Square Number, the Number given muſt be multiplied twice by the Side of the Square Number. Thus to find how many Square Feet there are in 53 Square Fathoms, it is known that a Square Fathom contains 36 Square Feet, and therefore that 53 muſt be multiplied by 36; and as the Square Root or Side of 36 is 6, you muſt multiply 53 by 6, and the Product 318 again by 6, and the Second Product 1908. will be that which is requir'd.

53	*Square Fathoms.*
6	
318	
6	
1908	*Square Feet.*

The ſame Principle teaches us, that to multiply a given Number by a *Solid Number*, that is to ſay, by a Number that has three producing Numbers, or which ſhall be produc'd by the mutual Multiplication of three others, which are the *Sides* of this ſolid Number; you muſt multiply the given Number by one Side, and the Product by one of the two other Sides, and the Second Product by the third Side. Thus

Thus to multiply 36 by 144, it is known that 144 is a ſolid Number, whoſe three Sides are 6, 6, 4, you muſt multiply 36 by 6, and the Product 216 by 6, and the Second Product 1296, by 4, the third Product will be that required.

```
  36
   6
----
 216
   6
----
1296
   4
----
5184
```

7. From whence it is eaſy to conclude that to multiply a given Number by a Cube Number, which is a Solid Number, whoſe three Sides are equal, you muſt multiply the given Number three times by the Side of the Cube.

So to find how many Cubic Feet there are in 43 Cubic Fathoms, 'tis known that a Cubic Fathom contains 216 Cubic Feet, and as the Cubic Root or Side of 216 is 6, you muſt multiply 43 by 6, and the Product 258, again by 6, and the Second Product 1548 once more by 6, and the third Product 9288 will be that which is requir'd.

```
  43 Cubic Fathoms
   6
----
 258
   6
----
1548
   6
----
9288 Cubic Feet.
```

In like manner to find how many Geometrical Paces 324 Stades contain, it is plain that ſince a Stade contains 125 Geometrical Paces, you muſt multiply 324 by 125, but becauſe the Cube Root of this Number 125 is 5, you muſt multiply 324 by 5, and the Product 1620 again by 5, and the Second Product 8100 again by 5.

```
  324 Stades.          324000
    5                       8     [40500
-----                  ------
 1620
    5
-----
 8100
    5
-----
40500 Paces.
```

Since it happens that this Number 125 being multiplied by 8, produce 1000, it follows that if to the given 324 you add toward the right hand three Cyphers, you will have

324000

324000, which is the Product of 324 by 1000, or by 8 times 125, and conſequently if you take the 8th Part of 324000, you will have 40500 as before, for the Product of 324 by 125, or for the Number of Geometrical Paces, which are contain'd in 324 Stades.

There are ſeveral other Abridgements of this Nature that are very curious and uſeful, which we ſhall here paſs over. We ſhall add only one other Compendium, which may be very uſeful on ſeveral Occaſions, chiefly for the Reduction of high Denominations into lower ones, and likewiſe opens the Way to ſeveral other Abridgements.

```
524 Toiſes.
  864
-----------
 4192
33536
-----------
452736 Lines.
```

To find for Example, how many Lines there are in 524 Toiſes, you know that a Toiſe contains 864 Lines, 524 ought to be multiplied by 864, which may be done by two Multiplications only, altho' the Multiplicator 864 be compos'd of three Figures, becauſe the firſt Figure 8 towards the left hand is compriz'd 8 times in the two others 64, which in this caſe will be conſider'd as one only Figure. Wherefore having for greater facility diſpos'd the two Members to be multiplied, as you ſee here, you muſt begin to multiply 524 by 8, and the Product 4192, by 8, which is the Number of times that the firſt Figure 8, towards the left hand of the Multiplicator 864 is contain'd in the two others 64, and you'll have this Second Product 33536, which is the Product that wou'd ariſe by multiplying 524 by 64, and conſequently ought to be plac'd as you ſee here; and the Sum of theſe two Products will give 452736, the Number of Lines in 524 Toiſes.

PROBLEM VI.

Compound Multiplication.

Compound Multiplication teaches the manner of multiplying a Sum compos'd of ſeveral different kinds or Denominations, by an abſolute Number, or by another Sum compos'd alſo of ſeveral different kinds. Variety of Caſes may happen, which we ſhall explain in order in the following Examples.

EXAMPLE.

To find how much 67 Ells of Cloth will coſt at 6 *l.* 4 *s.* 2 *d.* the Ell. You muſt multiply theſe 6 *l.* 4 *s.* 2 *d.*

67

67 *Ells*	67	67
6 *l.* 4 *s.* 2 *d.*	4	2
402 *l.*	268 *s.*	134 *d.*
13 *l.* 8 *s.* *for the* 4 s.		
11 *s.* 2*d.* *for the* 2 *d.*		
415 *l.* 19 *s.* 2 *d.* *Product.*		

by the absolute Number 67, by writing it above the Pounds, as you see here, and multiplying 67 by 6, gives 402 *l.* which must be written under the Line; after that you must multiply apart the same absolute number 67 by 4 *s.* and you'l have 268 *s.* or 13 *l.* 8 *s.* which must be put under Pounds and Shillings; then you must multiply also apart the same absolute Number 67 by 2 *d.* and you'll have 134 *d.* or 11 *s.* 2 *d.* which must be written under the Shillings and the Pence. Lastly, having drawn a second Line under these three Products, you must add them together, and the Sum will shew, that 67 Ells will cost 415 *l.* 19 *s.* and 2 *d.* This is readily proved by Division, as has been already said in the preceding Problem.

To reduce Shillings into Pounds, for Example 268 *s.* you must divide these 268 *s.* by 20, it being certain that as often as 20 is contain'd therein, so many Pounds there shall be, because a Pound is 20 Shillings: But because we do not yet know Division, make Use of this Abridgment. Since the Number by which we are to divide is 20, or the significant Figure is 2, take the half of all the Figures of the given Number 268, except the last 8, towards the right hand, beginning towards the left, saying the half of 2 is 1, and the half of 6 is 3, and these two halves compose the Number 13, which represents 13 *l.* and the Number 8 which remains is 8 *s.* so that 268 *s.* make 13 *l.* and 8 *s.*

To reduce Pence into Shillings, for Example 134 Pence, you must divide these 134 *d.* by 12, it being certain, that so many times as 12 is contain'd in 134, so many Shillings will there be, because a Shilling is 12 Pence. But because we do not yet know Division, you must substract 12 from 134 as many times as is possible, and retain one Shilling for each time; or because 12 has these two producing Numbers 3, 4, you must consider the given Number 134 as a Sum of Shillings, which you must divide by 3, and the Quotient by 4, because the fourth of a third is a twelfth. Tho' this supposes that you know Division, which we have not yet taught, however the Practice of it will be easy, by saying first, the third of 13 is 4, or 4 Tens, and there remains

mains 1 Ten, which, with the 4 following make 14, the third of which is 4 Units, ſo that I have 44 Shillings, and there remains yet 2 Shillings, or 24 Pence, the third of which is 8 Pence. So that the third of 134 *s* is 44 *s.* 8 *d.* of which you muſt take the fourth, which may be done in the ſame manner and you'l find 11 *s.* 2 *d.* for the value of 134 *d.*

But this Reduction may be made a great deal eaſier by an Abridgment, which is common among Meaſurers, Merchants, and Tradeſmen, becauſe it is very convenient, and for that reaſon we ſhall not neglect it here, but ſhall explain it in as plain a manner, as is poſſible, as well in the preceding Example, as in the following ones.

To find then, in this Example, at once what ought to produce 67 times 4 Shillings; or 4 Shillings multiplied by the abſolute Number 67, you muſt conſider that if in the place of 4 Shillings, you had 20 *s.* or a Pound, the Product would be 67 *l.* but becauſe there is but 4 *s.* which is exactly the fifth part of a Pound, there will be produced but the fifth part of 67 Pounds. Thus in the Practice you muſt take the fifth part of the abſolute Number 67, by ſaying the fifth part of 6 is 1, which is 1 Ten, and there yet remains 1 Ten, which with the following Figure 7, makes 17, the fifth part of which is 3, which is 3 Units, ſo that you will have 13 *l.* and there will remain yet 2 *l.* which is 40 *s.* whereof the fifth part is 8 *s.* but you would have done ſooner by multiplying the remaining Number 2 by 4, which is the Number of Shillings, becauſe this remaining Number 2, holds the place of the abſolute Number which muſt be multiplied by 4 *s.* Thus you will have 13 *l.* 8 *s.* for the product of 4 *s.* multiplied by the abſolute Number 67.

In like manner to find by one ſingle Operation what is 67 times 2 *d.* or 2 *d.* multiplied by the abſolute Number 67; you muſt conſider, that if in the place of 2 *d.* you had 12 *d.* or a Shilling, the Product wou'd be 67 *s.* but as there are but 2 *d.* which is but the ſixth part of a Shilling, the Product will be juſt the ſixth part of 67 *s.* So in the Practice you muſt take the ſixth part of the abſolute Number 67, by ſaying, the ſixth part of 6 is 1, which is one Ten, and as there remains nothing, you muſt ſay, the ſixth part of 7 is 1, which is one Unit, ſo that you will have 11 *s.* and there will remain 1 *s.* which is 12 *d.* the ſixth part of which is 2 *d.* which will be had eaſier by multiplying the remaining Number 1 by 2, which is the Number of Pence. Thus you will have 11 *s.* 2 *d.* for the Product requir'd.

You ſee here that the Pence produce Shillings, and the Shillings Pounds, and it will appear in the ſame manner that Inches produce Feet, and Feet Yards; for it is eaſie to judge by

by the preceding Reaſoning, that any Denomination whatſoever being multiply'd by an abſolute Number, produces the Denomination immediately higher, namely that with reſpect of which the Number of the lower Denomination is at an aliquot Part of. But it may happen that it will not be an aliquot Part; in this Caſe it muſt be reduc'd into two or three other Numbers, which ſhou'd be aliquot Parts, which may be eaſily done, as you ſhall ſee in the following Examples.

EXAMPLE 2.

To find how many *Livres* there are in 53 *Crowns*, a *Crown* being worth 3 *Livres* 6 *Sols*, you muſt firſt multiply 53 by 3 *Livres*, and you will have 159 *Livres*, which muſt be written under the Line, as you ſee here: And becauſe 6 *Sols* are not an aliquot Part of the *Livre*, that is to ſay, that 6 does not exactly divide 20, it muſt be reduc'd into theſe two, 4, 2; whereof the firſt, 4, is the fifth Part of 20; and the laſt, 2, is the tenth Part of it. You muſt take then the fifth Part of the abſolute Number 53, which ought to be conſider'd as *Livres*, and you will have 10

53 *Crowns.*		
3 *Liv.*	6 *Sols*,	*the value of a Crown.*
159 *Livres.*		
10 *Liv.*	12 *Sols*	*for the* 4 *Sols.*
5 *Liv.*	6 *Sols*	*for the* 2 *Sols.*
174 *Liv.*	18 *Sols*,	*the value of* 53 *Crowns.*

Livres 12 *Sols*, and the tenth part of the ſame abſolute Number 53, which is 5 *Livres* 6 *Sols*. Writing theſe two Products as you ſee here, and adding together the three Products which are under the Line, you will have 174 *Livres* 18 *Sols*, for the value of 53 *Crowns*; which may alſo be foundby another Abridgment; namely, by multiplying 53 by 33 *Livres*, which are the value of 10 *Crowns*, and by dividing the Product 1749 *Livres* by 10, that is to ſay, by taking away the firſt Figure 9 towards the right hand, which being doubled, will repreſent 18 *Sols* beſides the 174 *Livres*, &c.

EXAMPLE 3.

To find how much a Person ſhall ſpend in a Year, or in 365 Days, at the Rate of 3 *l.* 16 *s.* 11 *d.* a Day, you muſt reduce the 16 *s.* into 10, 4, 2, which are the half, the fifth part, and the tenth part of a Pound: and in like manner the 11 *d.* into theſe three, 4, 4, 3, which are two thirds and a fourth of a Shilling; after which you muſt work as has been ſaid,

365	*Days in a Year.*		
3 *l.*	16 *s.*	11 *d.*	*Expence in a Day.*
1095	00	00	
182	10	00	*for the* 10 *s.*
73	00	00	*for the* 4 *s.*
36	10	00	*for the* 2 *s.*
00	121	08	*for the* 4 *d.*
00	121	08	*for the* 4 *d.*
00	91	03	*for the* 3 *d.*
1403 *l.*	04 *s.*	7 *d.*	*Expence of a Year.*

and as you ſee here, and the Sum of all the Products will give 1403 *l.* 4 *s.* 7 *d.* for the Expence of a Year.

EXAMPLE 4.

If the Sun's mean Motion be 59 Minutes, and 8 Seconds a Day, how much is it in 31 Days? You muſt multiply

	31		*Number of Days.*
	59′.	8″.	*Diurnal Motion.*
15°.	30′.		*for the* 30 *Minutes.*
10.	20.		*for the* 20 *Minutes.*
2.	35.		*for the* 5 *Minutes.*
2.	4.		*for the* 4 *Minutes*
	2.	4″.	*for the* 4 *Seconds.*
	2.	4.	*for the* 4 *Seconds.*
30°.	33′.	8″.	*Motion in* 31 *Days.*

59′. 8″ by 31: For this end you muſt reduce 59 Minutes into theſe four aliquot Parts, 30, 20, 5, 4, which are the half, the third, the twelfth, and the fifteenth part of a Degree, or 60 Minutes: And in like manner you muſt reduce the 8 Seconds into theſe two aliquot Parts, 4, 4, each whereof is the fifteenth part of a Minute or 60 Seconds. Then you muſt work as before, and as you ſee here, and the

the Sum of all the Products will give 30 Degrees, 33 Minutes, and 8 Seconds, for the mean Motion of the Sun in 31 Days.

An Infinity of other Queſtions might be given, to ſhew the Uſe of Multiplication, and to which it may be apply'd: but I believe that the preceding Examples may ſuffice, becauſe a Mathematician ought to have Sagacity enough to apply things of this nature himſelf. You will have other Examples of it in the *Rule of Three*, and in *Practical Geometry.*

PROBLEM VII.

Single Diviſion.

SIngle Diviſion teaches the manner of dividing an abſolute Number by another abſolute leſs Number, to know how many times that leſs Number, which is call'd *Diviſor*, is contain'd in the greater, which is call'd *Dividend*, which contains as many times the Diviſor as the Quotient contains Units.

There are ſeveral different ſorts of Diviſion, which I ſhall not here explain, leaving that to thoſe who depend on a Book of Arithmetick, my Intention being to put nothing in this Treatiſe, nor in the others, which is not neceſſary and of uſe. Thus I ſhall content myſelf in giving you here one only way of Diviſion, namely that which I always practis'd and taught, becauſe in the Practice it ſeems to me the moſt convenient of all, without giving my ſelf the trouble to examine whether it is the *Italian* or the *Spaniſh* way.

Firſt, if the Diviſor is a ſingle Figure, for example 6, as if you would know how many Fathoms in 20736 Feet, in which caſe you muſt divide 20736 by 6, becauſe a Fathom

20736	*Dividend.*	3456	*Quotient.*
6	*Diviſor.*	6	*Diviſor.*
27	C.	20736	*Proof.*
6			
33	B.		
6			
36	A.		
6			
0			

contains 6 Feet. For this end you must begin the Division towards the left hand of the Dividend, by placing the Divisor not under the 2, because this Number is less than 6, which must be done if it be equal or greater, but under 20, so that the 6 be put below the 0, as you see here: After which you must draw a Line underneath, and another towards the right hand to put the Quotient in, which you will find in this manner.

I say 6 in 20 is 3 times, I put 3 in the Quotient after the Line towards the right hand, and multiplying the Divisor 6 by the Quotient 3, I substract the Product 18 from the superior Number 20, and I write the Remainder 2 below the Line under the Divisor 6. After that I bring down the following Figure 7 of the Dividend, and annex it to the remaining Number 2, and you'll have 27, which I divide in the same manner by 6, by placing the 6 under the 7 brought down, and saying, after having drawn a Line underneath, 6 is in 27 4 times, I put down 4 in the Quotient, on the right hand of the first found Figure 3, and multiplying the Divisor 6 by this second Figure 4, I substract the Product 24 from the superior Number 27, and I write the Remainder 3 below the Line under the Divisor 6. In like manner I take down the following Figure 3 of the Dividend, and annex it to the 3 that remain'd; then I have 33, which I divide in the same manner by 6, placing the 6 under the 3 brought down, and saying 6 in 33 5 times, I put down 5 in the Quotient, at the right hand of the two first found Figures 34, and multiplying the Divisor 6 by this third found Figure 5, I substract the Product 30 from the superior Number 33, and I write the Remainder 3 below the Line, under the Divisor 6. Lastly I take down the last Figure 6 of the Dividend, and annex it to the remaining Number 3, and it gives 36, which I divide by 6, by placing the Divisor 6 under the 6 brought down, and saying 6 is in 36 6 times; I put down 6 in the Quotient on the right hand of the three first found Figures 345, and multiplying the Divisor 6 by the fourth found Figure 6, I substract the Product 36 from the superior Number 36, and as there remains nothing, I write an 0 under the Line, and the Division is finish'd, because all the Figures of the Dividend have been taken down, and consequently all the Dividend has been divided. And the Quotient will be 3456, for the number of Fathoms which are contain'd in 20736 Feet: This must be prov'd by Multiplication, namely by multiplying the Quotient 3456 by the Divisor 6, and adding to the Product the Remainder, if any be. For it is evident that if the Division be well done, the Dividend will be the Product.

This

This Proof evidently shews the Demonstration of the Practice of Division; for the same Multiplications which are made in Division, are made in the Proof, when you multiply the Quotient by the Divisor; so that the same Products are met with in one and the other, with this difference, that these Products are substracted in the Division, and added in the Proof, that is to say, in Multiplication. Thus in the Proof, when you multiply 6 by 6, you have the Product 36, which are the two first Figures towards the right hand of the Dividend, and which are at A. Afterwards when you multiply 5 by the same 6, and in the Product 30, you add the 3 Tens, which were retain'd in the preceding Multiplication, you have 33, which are the two Figures of the Row immediately higher at B. Afterwards when you multiply 4 by the same 6, and to the Product 24 you add the 3 Tens which were to be retain'd by the preceding Multiplication, you have 27, which are the two Figures of the highest Row C. Lastly when you multiply 3 by the same 6, and to the Product 18 you add the two Tens which were retain'd in the preceding Multiplication, you have 20, which are the two Figures at the left hand of the Dividend, by which you begun to make the Division. Having thus given you an insight into the manner, you'll easily comprehend the rest of the Demonstration.

When the Divisor has more than one Figure, as 12, for example if you would reduce 576 Inches into Feet, or 576 Pence into Shillings: In this case you must divide 576 by 12, because a Foot is 12 Inches, and likewise one Shilling is 12 Pence. To do this, you must put as before, and as you see here, the Divisor 12 under the first Figures at the left hand of the

576 *Dividend.*
12 *Divisor.*

96	(48 *Quotient.*
12	12
	48
	96
	576 *Proof.*

Dividend, that is to say under 57, that you may see how many times this Divisor 12, is compriz'd in it's superior Number 57: And as that is not always easy to be known, you must first see how many times the first Figure 1 of the Divisor is contain'd in the first 5 of the Dividend; and tho'

 is

it be there 5 times, nevertheleſs you muſt not put 5 in the Quotient, becauſe the ſecond Figure 2 is not compris'd 5 times in the remaining part of 57, which ſhews that the Diviſor 12 is not 5 times in the whole ſuperior Number 57. It muſt be then diminiſh'd by an Unit, and inſtead of 5 times you muſt take but 4 times, that is to ſay, inſtead 5 you muſt put only 4 in the Quotient, becauſe 12 is compris'd 4 times in 57, which is readily ſeen by reaſon of the firſt Figure 1 of the Diviſor being taken 4 times in the firſt Figure 5 of the Dividend, there remains yet 1, which with the following Figure 7, makes the Number 17, in which the ſecond Figure 2 of the Diviſor is contain'd 4 times ; otherwiſe you muſt again diminiſh the Quotient by an Unit, and that as many times till the Diviſor multiplied by the Quotient may be ſubſtracted from the ſuperior Figures of the Dividend; where you muſt take care alſo of not taking the Quotient too little, for as it is a fault to put in the Quotient a figure too great, ſo it is alſo to put a figure there which is too little ; which you will know after having ſubſtracted the Diviſor multiplyed by the Quotient from the ſuperior figures of the Dividend, if there remains under the Line a Number equal or greater than the Diviſor. Putting then 4 in the Quotient towards the right hand, you muſt multiply as in the firſt Example, the Diviſor 12 by this firſt found Figure 4, and you muſt ſubſtract the Product 48 from the ſuperior Number 57, and put the Remainder 9 under the Line. But to do that readily and Methodically, you muſt ſay 4 times 2 make 8, and 8 from 7 I cannot, ſay then by borrowing one Ten, 8 from 17 there remains 9, which you muſt write under 2, and carry 1 for one Ten borrow'd. Say afterwards 4 times 1 make 4, and 1 which I carry'd make 5, which being ſubſtracted from 5, there remains nothing, wherefore you muſt put nothing at all below, for the 0 which ought to be put being preceded by no ſignificant Figure, will be of no uſe. After take down the following Figure 6 of the Dividend, and annex it to the remaining Figure 9, and you will have 96, which muſt in like manner be divided by 12, by ſaying, in 9 how many times 1? and having found by a reaſoning like the preceding, that by reaſon of 2 it is but 8 times, you muſt put 8 in the Quotient; and ſay 8 times 2 make 16, and 16 from 6 I cannot, borrow then one Ten, and ſay 16 from 16, and there remains nothing, and for that reaſon put an 0 underneath, and retain 1 for the Ten borrow'd. Say again, 8 times 1 make 8, and 1 which I retain'd make 9, which being ſubſtracted from the 9, there remains nothing. Thus the Quotient will be 48, which ſhews that in

576

576 Inches there are 48 Feet, or that in 576 Pence there are 48 Shillings.

SCHOLIUM.

It often happens that in a Diviſion made at ſeveral times, the Number remaining join'd with the following Figure of the Dividend, which was taken down, is leſs than the Diviſor; which hinders its being divided: In this Caſe it is unuſeful to put the Diviſor under, ſince it is compris'd only once; but for the Figure which you took down, you muſt put an o in the Quotient, and after having took down the other following Figure of the Dividend, you muſt continue the Diviſion, as has been taught before, and as you ſhall ſee in this

EXAMPLE.

A great Lord hath 110960 Livres Rent *per Annum*, and it is requir'd how much he hath to ſpend a Day, which will be done by dividing 110960 by 365, which is the Number of Days in a common Year. This Diviſion muſt be done thus.

Having written the Diviſor under the Dividend, according to the Rules preſcrib'd before, and as you ſee here; I ſay 3 is in 11 3 times, I write 3 in the Quotient towards the right hand, after which I ſay 3 times 5 make 15, and 15 from 9 I cannot, I borrow therefore 1 Ten, and ſay 15 from 19 and there remains 4, which muſt be written at the

110960	*Dividend.*	(304	*Quotient.*
365	*Diviſor.*	365	
1460		1520	
365		1824	
000		912	
		110960	*Proof.*

bottom under 5, and retain 1 for the 10 borrow'd. Say afterwards 3 times 6 make 18, and 1 which I retain'd makes 19, and 19 from 0 I cannot, ſay then 19 from 20, borrowing 2 Tens becauſe one is not ſufficient, there remains 1, which muſt be written at the Bottom under 6, and retain 2 for the two Tens borrow'd. Say again 3 times 3 make 9, and 2 retain'd make 11; 11 from 11 and there remains nothing, ſo put nothing down. After that take down the following Figure 6 of the Dividend towards the right hand nigh the remaining Figure 14, to have this other Number

146, which cannot be divided by 365, wherefore you must put 0 in the Quotient, on the right hand of the first found Figure 3. Afterwards take down the following Figure 0 of the Dividend nigh the Number 146, to have this other Number 1460, which may be divided by 365: Wherefore you must write the Divisor 365 under 1460, so that the first Figure 5 be under the first figure 0 towards the right Hand, and the others in order towards the left; after which you must say 3 in 14 is 4 times, and you must put 4 in the Quotient after 0 towards the right hand; and as there remains nothingafter having multiply'd and substracted, and all the Figures of the Dividend taken down, you may conclude that in dividing 110960 by 365, the Quotient is exactly 304, for the Number of Livres which the Lord might spend a Day.

If there remains any thing after the Division is ended, you must write this Remainder after the Quotient towards the right hand, and the Divisor under, with a Line between them, in the form of a Fraction, to shew that there remains such a Number to be divided by that at the bottom, which is the Divisor. Or you must reduce by Multiplication that Remainder into lower kinds, when there are any, to the end the Division may be done; as you shall see in the following Example.

EXAMPLE.

A Person would distribute 315 *l.* among 24 People, so that each should have an equal Share; which will be found by dividing 315 by 24, thus.

Having divided as has been taught before, and as you see here, 315 by 24, you have 13 *l.* in the Quotient, and there remains 3 *l.* which must be reduc'd into Shillings by multiplying 'em by 20, because a Pound is 20 Shillings, and instead of 3 *l.* you will have 60 Shillings, to be divided by 24, and you will have 2 *s.* in the Quotient, and there remains 12 Shillings, which must be reduc'd into Pence by multiplying 'em by 12, because a Shilling is 12 Pence, and in the room of 12 Shillings you will have 144 Pence to be divided by 24, which gives 6 Pence in the Quotient, and in all will be 13 *l.* 12 *s.* 6 *d.* for the Share of each of the 24 Persons.

315 *Dividend.*	24 *Divisor.*
24 *Divisor.*	13 *l.* 2 s. 6 *d.* *Quotient.*
75	72
24	24
	2 *l.* 8 s. *for the* 2 *s.*
3 *l.*	12 *s.* *for the* 6 *d.*
20	
60 *s.*	315 *l.* *Proof.*
24	
12 *s.*	
12	
24	
12	
144 *d.*	
24	
00	

As the Divisor 24 is a *Compound Number*, that is to say a Number which is produc'd by Multiplication of two others, namely 4, 6, which elsewhere we have call'd producing Numbers, and are commonly call'd *Aliquot Parts*, because they exactly divide the Number 24, of which they are just parts, to make them different from *Aliquant Parts*, which are not just parts of their whole: And the Division of a Number by a single Figure is easy; so that you may abridge the Operation by taking the fourth of 315 *l.* and of this fourth 78 *l.* 15 *s.* take the sixth part, which will give as before 13 *l.* 2 *s.* 6 *d.* for the share requir'd.

There are no considerable Abridgments when the Divisor is a *Prime Number*, that is to say a Number which is not exactly divided by any other Number than by a Unit; otherwise there are a great Number of compendious ways, which those that have never so little practice in Accounts may easily invent. So it seems to me unnecessary to give here any particular Examples of them. I shall only say that when the Divisor is compos'd of an Unit and as many Cyphers as you will, as 10, 100, 1000, &c. there is nothing to do but to cut off from the Dividend as many Figures towards the right hand as the Divisor has Cyphers, and these Figures cut off will be the Remainder, and those towards the left hand represent the Quotient, *&c.*

PRO-

PROBLEM VIII.

Compound Division.

COmpound Division teaches to divide an abſolute Number by another compos'd of different Denominations: or a Number compos'd of ſeveral different ſpecies by an abſolute Number, or by a Number compos'd alſo of ſeveral different ſpecies. We ſhall give Examples of all theſe Caſes.

EXAMPLE I.

A Merchant gave 200 *l.* 10 *s.* 8 *d.* for 32 Ells of Cloth, and he would know how much it coſts him the Ell. To this end you muſt divide 200 *l.* 10 *s.* 8 *d.* by 32, thus:

Having divided 200 *l.* by 32, you have 6 *l.* in the Quotient, and there remains 8 *l.* which I reduce into Shillings by multiplying 'em by 20, and inſtead of 8 *l.* I have 160 *s.* to which I add the 10 *s.* of the Dividend, and

200 *l.* 10 *s.* 8 *d.* *Dividend.*
32 *Diviſor.*
8 *l.*
20
160 *s.*
10
170 *s.*
32
10 *s.*
12
20
10
120 *d.*
8
128 *d.*
32
00

32 *Diviſor.*
6 *l.* 5 *s.* 4 *d.* *Quotient.*
192 *l.*
8 *l.* *for the* 5 *s.*
10 *s.* 8 *d.* *for the* 4 *d.*
200 *l.* 10 *s.* 8 *d.* *Proof.*

I have

I have 170 *s.* which being divided by 32, I have 5 *s.* for the Quotient, and there remains 10 *s.* which I reduce into Pence by multiplying them by 12, and then I have 120 *d.* to which I add the 8 *d.* of the Dividend, and I have in all 128 *d.* which being divided by 32, give just 4 *d.* for the Quotient. So that the whole Quotient will be 6 *l.* 5 *s.* 4 *d.* for the value of an Ell.

EXAMPLE 2.

If the Sun by its proper Motion goes thro' the whole Zodiack in 365 Days, 5 Hours, 44 Minutes, it is demand-

Days. *Hours.* *Minutes.*
365 5 44 *Divisor.*
24

1460
7305

8765 *Hours.*
60

525900 *Minutes.*
44

525944 *New Divisor.*
Degrees.
360 *Dividend.*
60

21600 *Minutes.*
60

1296000 *Seconds.*
525944 (2''. 27'''. *Quotient.*

244112 *Seconds.*
60

14646720 *Thirds.*
525944

4127840
525944

446232

ed

ed how much of the Zodiac it will paſs thro' by it's mean or equal Motion in the ſpace of a Minute of Time. To find this, it is evident you muſt divide 360 Degrees by 365 Days, 5 Hours, 44 Minutes; and as this Diviſor is compos'd of different Denominations, it muſt be reduc'd into the loweſt, namely by multiplying 365 Days by 24 Hours, becauſe a Day contains 24 Hours, in order to have in their room 8760 Hours, to which you muſt add the 5 Hours which are over and above, and inſtead of 365 Days 5 Hours, you will have 8765 Hours, which muſt be reduc'd into Minutes by multiplying them by 60, becauſe an Hour contains 60 Minutes, in order to have 525900 Minutes, to which you muſt add the 44 Minutes which are over and above, and you will have 525944 Minutes, which muſt be conſider'd as an abſolute Number for a new Diviſor, which is greater than the Dividend 360 Degrees, and conſequently muſt be reduc'd into Minutes by multiplying them by 60, becauſe a Degree contains 60 Minutes, and you will have this other Dividend 21600, which is yet too little; wherefore it muſt be reduc'd into Seconds by multiplying theſe 21600 Minutes by 60, becauſe a Minute contains 60 Seconds, and you will have 1296000 Seconds for the new Dividend; which being divided but the new found Diviſor 525944, you have 2 Seconds for the Quotient, and there remains 244112 Seconds, which I reduce into Thirds by multiplying 'em by 60, becauſe a Second hath 60 Thirds, and I have 14646720 Thirds, which being divided by 525944, there reſults 27 Thirds in the Quotient, and remains 446232 Thirds, which may alſo be reduc'd into Fourths, in order to have Fourths in the Quotient; but as the Remainder is of ſmall conſequence, we ſhall paſs it by, and ſay that in a Minute of Time the Sun's mean Motion is 2 Seconds and 27 Thirds.

EXAMPLE 3.

A Captain laid out 368 *l.* 7 *s.* 6 *d.* for Shoes and Stockings for his Company, and each Man ſtood him in 3 *l.* 10 *s.* 2 *d.* the Queſtion is how many Soldiers there were in the Company? which will be found by dividing 368 *l.* 7 *s.* 6 *d.* by 3 *l.* 10 *s.* 2 *d.* To this end you muſt

reduce

```
3 l. 10 s. 2 d.        368 l. 7 s. 6 d.
20                      20
----                   -----
70                     7367
12                       12
----                   -----
140                    14734
702                    73676
----                   -----
842 Divisor.           88410 Dividend.

88410 Dividend.
842   Divisor.          (105 Quotient.
-----
4210
 842
-----
 000
```

reduce the Divisor and the Dividend into the lowest Denomination, that is to say into Pence, to have this new Divisor 842, and this new Dividend 88410; and the Quotient will be 105 for the number of Soldiers in this Company.

PROBLEM IX.

Extraction of the Square Root.

THE Extraction of the Square Root is the manner of extracting the Square Root from a Number that hath one, or of coming as near it as you please, when it hath not a Square Root.

This Method supposes that you know the Square Roots of all whole Numbers under 100, which have a Square Root. Thus, for example, 'tis necessary to know that the Square Root of 1 is 1, that the Square Root of 4 is 2, and so on, as you see in the following Table, which contains at the top all the simple Numbers from 1 to 9 inclusive, and at the bottom their Squares opposite to 'em, which were found by multi-

1	2	3	4	5	6	7	8	9	*Roots.*
1	4	9	16	25	36	49	64	81	*Squares.*

plying

plying each Root by it ſelf; where you ſee that a Number which has but two Figures can have but one in its Square Root. From whence it is eaſy to conclude, that a Square Number has as many Figures in its Square Root, as it is diviſible from two to two Figures, where it may happen that the laſt part ſhall have but one Figure, namely when the Number of Figures ſhall be odd, which hinders not the Square Root from having as many Figures as there are Parts or Cuttings-off. Thus it appears, that the Square Root of a Number compos'd of three or four Figures has two Figures; that the Square Root of a Number compos'd of five or ſix Figures has three Figures; and ſo of the reſt, by taking the greater half of the Number of Figures, when it is unequal.

And therefore when you would extract the Square Root of a given Number, it is divided by Strokes from two to two Figures, by proceeding from the right hand to the left, leaving at a venture in the laſt Stroke on the left hand one or two Figures, but never more; after which you begin to take the Square Root, or the neareſt and leaſt from this laſt Section, to have the firſt Figure of the Square Root requir'd, the double whereof will ſerve for the Diviſor afterwards, becauſe the Square Root is taken but once, as you ſhall ſee in this

EXAMPLE.

There is a Square which contains in its Superficies 214369 ſquare Fathoms; we would know the Side of this Square, that is to ſay, the number of Fathoms which this Side contains, which will be done by extracting the ſquare Root of 214369 in this manner.

Having divided the given Number 214369 from two to two Figures, by proceeding from the right hand to the left, as you ſee here, take the nigheſt and leaſt Square

21|43|69	(463 *Square Root.*
4	463
———	———
5 43	1852
86	2778
———	1389
2769	———
923	214369 *Proof.*
———	
000	

Root

Root of the laſt Section 21 towards the left hand, which is 4; this you muſt write under 21, and alſo at the right hand in form of a Quotient, for the firſt Figure of the Square Root requir'd. After that ſay 4 times 4 is 16, which being ſubſtracted from 21, there remains 5. This you muſt write beneath the Line under 4, as in the Diviſion; and this Remainder 5, with the following Section 43, which muſt be brought down towards the right hand, will make 543, and this you muſt divide by the double of the firſt found Figure, that is to ſay by 8, thus:

Double then the firſt found Figure 4, and write the double 8 under the laſt Figure ſave one of 543, beginning to reckon from the left hand towards the right, namely under 4, with this caution, that if this double ſhould expreſs it ſelf in more than one Figure, you muſt write only the laſt under the 4, and the reſt in their order under as many others of thoſe which are found towards the left hand; ſo that there remains a blank ſpace under 3, to put therein the ſecond Figure of the Root requir'd, which will be found by Diviſion, by ſaying the Eights in 54 is 6, put then 6 at the right hand in the blank ſpace under 3, and alſo next the firſt found Figure 4, at the right hand in form of a Quotient, for the ſecond Figure of the Root requir'd, and conclude the reſt as in Diviſion, and there will remain at the bottom 27, which with the following Section 69, which muſt likewiſe be brought down, make 2769, and muſt be divided in the ſame manner by the double 92 of the two firſt found Figures 46, by writing this double 92, under 2769, ſo that there remains at the right hand a blank ſpace under 9, to put therein the third Figure 3, which will be found by ſaying the Nines in 27 are 3, *&c.* Now becauſe there remains nothing after this laſt Diviſion, and all the Figures of the given Number were brought down, you may ſay that the ſame given Number 214369 is a perfect ſquare, and that its Square Root is preciſely 463, for the Number of Fathoms which each Side of the propos'd Square contains.

The PROOF.

Since any Number whatever, being multiply'd by it ſelf, produces it's Square, it follows that the Proof of the Square Root ought to be made by multiplying the Root found by it ſelf, and by adding to the Product the Figures which ſhall remain when the given Number ſhall not be ſquare; becauſe the ſaid Number ought to be found as here by multiplying 463 by 463, you have its Square 214369, which is the propos'd Number.

The

The Demonstration of the Method of Extracting the Square Root.

The Demonstration of the preceding Practice is evident *per* 4. 2. where we find that the Square of the Sum of two Numbers is equal to the Sum of the Squares of those two Numbers, and to the double of the Product under the same Numbers: which is the reason that when you take the Square Root of the last Section at the left hand, you have the greatest Number, because it represents Tens; and by reason of the double product under the two Numbers, and of the Square of the other Number, which are found in the Remainder, you ought to divide this Remainder by the double of the first found Number, to have the other which must be put in the blank place towards the right hand, to substract its Square from that which was left in the Remainder. Now altho' in the preceding Example the square Root 463 be compos'd of three Numbers, because it hath three Figures, it may be consider'd as compos'd of two Numbers only, by regarding the two first 46 as one single Number, which is equivalent to 460, and 'tis upon account of the Cypher which is understood, that a blank place is left at the right hand, to put therein the second Number which represents the Units, *&c.*

SCHOLIUM.

There is also in this Rule, as in Division, a Precaution to be taken touching the Quotient, which is found by dividing by the double of the first found Figure, it being possible likewise that this Quotient may become too great, not only by reason of the Figures of the Divisor, but also by reason of the second Figure which is put in the blank space towards the right hand, that you may be able to substract its Square, to which you must also have regard. The following Example will clear all this.

EXAMPLE.

I would place 1444 Soldiers in a square Batalion, and would know how many ought to be plac'd in each Rank, which will be found by taking the Square Root of 1444, thus;

14|44

14|44	(38 *Square Root.*
3	38
544	114
68	304
00	1444 *Proof.*

Having ſeparated the propos'd Number 1444 from two to two Figures, by beginning from the right hand to the left, as you ſee here, take the nigheſt and leaſt ſquare Root of the laſt Section 14, that is 3, which you muſt put towards the right hand in form of a Quotient, and alſo under 14, and after having made a line at the bottom, ſay 3 times 3 make 9, and 9 from 14 there remains 5, which you muſt write beneath the line under 3; and this remainder 5 with the two following Figures 44 make 544, which muſt be divided by 6, the double of the firſt found Figure 3, by ſaying in 54 how many times is 6 contain'd, and tho' it be 9 times you muſt however take but 8, becauſe the 9 being put in the blank place towards the right hand will not be found 9 times in the remainder, which is only 4, but in putting 8, this 8 will be found 8 times in the remainder, which will be 64. If then you put 8 in the Quotient at the right hand of the firſt found Figure 3, and alſo in the blank ſpace under 4, by multiplying and by ſubſtracting as has been done before, there remains nothing, which ſhews that the given Number 1444 is a perfect ſquare, the ſide whereof is 38, for the Number of Soldiers which muſt be put in each Rank, to make a ſquare Batallion of 1444 Men.

It often happens that the Number from which it is propos'd to extract the ſquare Root, is not a perfect Square, which is known when at the end of the operation any thing remains, and then if you neglect this remainder, you loſe ſomething, and to make the error leſs conſiderable, you muſt reduce the propos'd Number into lower Denominations, when there is any, which is eaſily done, by Multiplication, and the remainder of the Extraction of the Square Root will be inconſiderable, becauſe it will be but a part of the Denomination, and conſequently a very ſmall part of the whole, which will be ſo much leſs as the Denomination is of a lower Nature.

Thus if the propos'd Number repreſents ſquare Fathoms, they muſt be reduc'd into ſquare Feet, by multiplying them by 36, becauſe a ſquare Fathom hath 36 ſquare

Feet, and the square Root will represent current Feet, which may be reduc'd into current Fathoms, by dividing 'em by 6; and what shall remain after the extraction of the square Root will make but a part of a Foot, equivalent to some Inches, which may be found if you will, to the end that the error be yet less considerable, by reducing the square Feet into square Inches, by multiplying them by 144, because a square Foot contains 144 square Inches, and the square Root will represent current Inches, which may be reduc'd into current Feet, dividing them by 12, &c.

EXAMPLE.

I wou'd find the Side of a Square equal to a Superficies, which contains 32 square Fathom, which will be done by taking the square Root of 32 that is 5; and as there remains 7, which is equivalent to part of a Fathom, or some Feet, to find these Feet, you must multiply the 32 square Fathom by 36, and you will have 1152 square Feet, which you must make square Inches, by multiplying them by 144, to the end that the error that necessarily follows from a Number which is not square, shou'd be less considerable. Thus instead of 32 square Fathoms, you will have 165888 square Inches, the square Root whereof gives 407 current Inches, which are in value 5 Fathom, 3 Feet, and 11 Inches, for a side of a square equal to a Superficies, whose Area is 32 square Fathoms.

As this method is general and fundamental, it is a little tedious, but it may be abridg'd several ways, the best whereof is the following, which is likewise general and fundamental. It supposes the Fathom to have 10 Feet, and the Foot 10 Inches, and consequently the square Fathom hath 100 square Feet, and the square Foot 100 square Inches, and so on. From whence it follows, that on this supposition, to reduce a Number of square Fathom into square Feet, there is nothing to do but to put two Cyphers at the right hand of this Number, to have the square Feet, which must be reduc'd in like manner into square Inches, by writing two Cyphers at the right hand of the Number of square Feet, and so on: So that to reduce at once a Number of square Fathoms into square Inches, there is nothing to do but to put four Cyphers at the right hand of this Number. Thus 32 Square Fathoms will be reduc'd into 320000 square Inches, whereof the square Root 565 represents 565 Inches, of which

of

```
   32 Square Fathom.      16|58|88
   36                      4
  ----                    -------
  192                      5888
  96                        807
  ----                     -----
 1152 Square Feet.          239
  144
 -----
  4608
 4608
1152
------
165888 Square Inches.
------

Inches.
 (407       Feet.
  12        (33        Fathoms.
 ----         6         (5
   47        --
   12        3 Feet.
   --
   11 Inches.
```

there muſt be 100 to make a current Fathom; wherefore if you cut off two Figures at the right hand of the ſquare Root 565, the Number 5 which ſhall remain towards the left hand, will repreſent 5 current Fathoms, and the two Figures cut off will repreſent 65 Inches, of

```
 32|00|00        (5. 65
  5                  72
 -----            -----
 700                130
 106               455
 -----            -----
  6400             46|80
  1125             12    (3 Feet.
 ------           -----
   775             10 Inches.
```

which there muſt be 100 to make a Fathom. But becauſe according to cuſtom there needs but 72 to make a Fathom; if you multiply the 65 Inches by 72, and divide the Product 4680 by a 100 by cutting off two Figures at the right hand;

you will have according to custom 46 Inches, which are in value 3 Feet and 10 Inches, &c.

PROBLEM X.

The Extraction of the Cube Root.

THE Extraction of the Cube Root is the manner of extracting the Cube Root from a Number, when it hath one, or to come as nigh it as you will, when it hath none.

This method supposes that you know the Cube Roots of all those Numbers under 1000, which have one: Thus for Example, let it be known that the Cube Root of 1 is 1, that the Cube Root of 8 is 2, and so on, as you see in the following Table, which contains at the Top all the single Numbers, from 1 to 9 inclusive, and in the mid-

1	2	3	4	5	6	7	8	9	*Roots.*
1	4	9	16	25	36	49	64	81	*Square.*
1	8	27	64	125	216	343	512	729	*Cubes.*

dle their Squares, with their Cubes at the bottom opposite to 'em, which were found by multiplying each Square by its side, where you see that a Number which hath but three Figures, can have but one in its Cube Root. From whence it is easy to conclude, that a Cube Number hath as many Figures in its Cube Root, as it is divisible from three to three Figures, where it may happen that the last part shall have but one or two Figures, which hinders not the Cube Root's having as many Figures as there are Parts or Strokes. Thus it is known that the Cube Root of a Number compos'd of four, five, or of six Figures, hath two Figures, that the Cube Root of a Number compos'd of seven, eight, or of nine Figures, hath three Figures, and so for the rest.

This is the Reason that when you wou'd extract the Cube Root from a propos'd Number it is divided by cutting off from three to three Figures, beginning from the right towards the left, leaving at a venture in the last cutting off at the left hand, one, two, or three Figures, but never more: After which you begin to take the Cube Root, of the highest and least of this last Section, to have the first Figure of the Root requir'd, to divide afterwards the remaining Figures of the propos'd Number by the Triple of the Square of this first found Figure, as you shall see in this Ex-

EXAMPLE.

A Cube contains 103823 Cube Feet in its ſolidity, and the length of one of its ſides is requir'd, which will be found by extracting the Cube Root of 103823, thus.

Having cut the propos'd Number 103823 from three to three Figures, beginning at the right hand, and ſo on to the left, as you ſee here, take the nigheſt and leaſt Cube Root of the laſt Section 103 towards the left hand, which is 4, and muſt be written at the right hand, in form of a Quotient for the firſt Figure of the Root requir'd, and its Cube 64 under the ſame Section 103 that it may be ſubſtracted from it, and put at the bottom the remainder of the Subſtraction, which is 39, and which with the following Section 823 that muſt be brought down makes 39823.

This done, in order to find the ſecond Figure of the

	4		103|823
	4	*Cube.*	64
Square.	16		39823
	300		4800
Diviſor.	4800		6223
	7		5880
	7		343
	49	*Cube.*	343
	4		000
	196		
	30		
Subſtracted.	5880		
	(47	*Cube Root.*	
	47		
	188		
	329		
	2209		
	47		
	8836		
	15463		
	103823	*Proof.*	

Root requir'd, and in imitation thereof as many others as are to be found, when the propos'd Number ſhall be greater. multiply the firſt found Figure 4, by it ſelf, to have its Square 16, which muſt always be multiplied by 300, and you will have 4800, which you muſt write under the remaining Figures 39823, ſo that the firſt Figure towards the right hand anſwers under the firſt, and the others under the others in order, to ſerve for Diviſor, by ſaying how many times 4 is contain'd in 39? why 8 times; but becauſe of the reſult, it muſt be taken but 7 times. Putting then 7 at the right hand of the firſt found Figure 4, the Remainder of the Diviſion will be 6223, Multiply afterwards the ſecond found Figure 7, by its ſelf, to have its Square 49, which you muſt multiply by the firſt 4, and the Product 196, always by 30, to have this ſecond Product 5880, which muſt be ſubſtracted from the remaining Figures 6223, and there will remain 343, from whence you muſt again ſubſtract the Cube 343 of the ſecond found Figure 7, and as there remains nothing, you may conclude that the propos'd Number 103823 is a perfect Cube, and that its Cube Root is exactly 47, for the Number of current Feet which each ſide of the propos'd Cube contains.

The PROOF.

Since any Square whatſoever being multiplied by its ſide produces the Cube of that ſide, it follows that the Proof of the Cube Root ought to be made by multiplying the found Root by its ſelf, to have its Square, and its Square by the ſame Root, and by adding to the Product the Figures, which ſhall remain, when the propos'd Number ſhall not be Cubic, becauſe the propos'd Number ought to be found, as here by multiplying 47 by 47, you have its Square 2209, which being multiplied again by 47, you have its Cube 103823, which is equal to the propos'd Number without adding any thing, becauſe there was nothing remaining.

The Demonſtration of the Practice of extracting the Cube Root.

The Demonſtration of the preceding Practice is evident, by what we ſaid in our Algebra, namely that the Cube of $a+b$ is $aaa+3aab+3abb+bbb$, the Root $a+b$ repreſenting the found Root 47, and the Cube, $aaa+3aab+3abb+bbb$ the

the propos'd Number 103823; so that, if a be taken for the first found Figure 4, which is 40, you must take b for the second found Figure 7, which simply represents Units. Thus you ought to begin to substract the Cube aaa, which is equal to 64, or 64000, when you have found a or 40; and to find b you must by reason of $3aab$ which follows towards the right hand, divide the Remainder by $3aa$, which is equal to 4800, as hath been done, after which you must substract from the Remainder the solid $3abb$ which is equal to 5880, and from the Remainder the Cube bbb, which is 343, as hath been done

SCHOLIUM.

When the Cube Root of the propos'd Number shall have more than two Figures, you must bring down as before, the three Figures of the following Section next the remaining Figures at the right hand, and find the third Figure as we found the second, by considering the two first found ones as one single one, *&c.*

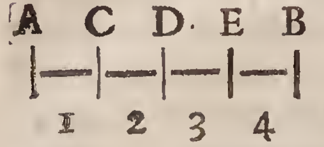
You may also come as nigh as you will to the Cube Root of a propos'd Number which is not a perfect Cube, by a reasoning like to that which we us'd in the Square Root; and therefore think it will be unnecessary to give any particular Example of it here.

PART II.

Of Broken Numbers, or Fractions.

WE have explain'd in *Def.* 2. *Part* 1. what a Broken Number, or Fraction is, and we shall say here that it is so call'd, because it represents one or more parts of a Unit, which is call'd an *Integer*, and is divided into some Number of equal parts, which Number gives the name to the Fraction, and this name is commonly call'd *Denomination*, because it gives the Denomination to the Fraction, shewing whether they are thirds, fourths, *&c.*

As if the Unit or Integer AB, one Ell for Example be divided into four equal parts at the Points C, D, E, the parts AC, AD, AE, are call'd, the Fractions of the Ell AB, the firſt whereof AC, whch is a fourth part, is expreſs'd thus, $\frac{1}{4}$, the ſecond AD, which comprehends two fourth parts, thus $\frac{2}{4}$, and the third AE, which contains three fourth p rts, thus $\frac{3}{4}$.

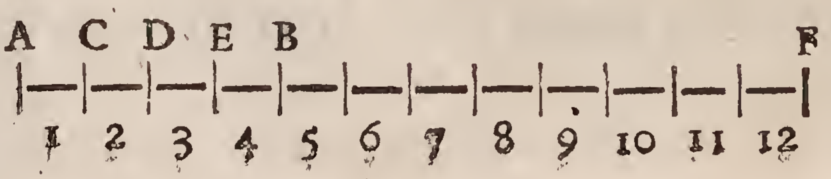


By this you ſee that a Fraction is expreſs'd by two Numbers, ſeparated by a little line, the uppermoſt whereof is call'd *Numerator*, becauſe it expreſſes the Number of parts taken from the whole, and the undermoſt is call'd *Denominator*, becauſe it gives the name and the denomination to the Fraction. Thus in the laſt Fraction, AE, which is $\frac{3}{4}$, the Numerator is 3, and the Denominator 4.

You ſee alſo that a Fraction is leſs than the whole, or an Unit, when the Numerator is leſs than the Denominator, as the preceding Fraction $\frac{3}{4}$, and it is equal to an Unit, when the Numerator is equal to the Denominator, as $\frac{4}{4}$, and laſtly it is greater than an Unit, when the Numerator is greater than the Denominator, and then it is call'd improper Fraction as $\frac{5}{4}$, which is as much as 1 and $\frac{1}{4}$, which will be found by dividing the Numerator 5 by the Denominator 4.

All the preceding Fractions are ſaid to be *of the ſame Denomination*, or *of the ſame kind*, becauſe they are parts of the Unit divided into one and the ſame number of equal parts, that is to ſay becauſe their Denominators are equal; otherwiſe they are ſaid to be *of a different Denomination*, or *of a different Kind*, as $\frac{2}{3}$, and $\frac{3}{4}$, becauſe their Denominators 3 and 4 are unequal. All Shillings are Fractions of the ſame Denomination with reſpect of the Pound, which goes for the *Whole*, or for the Unit, and in like manner all Pence are Fractions of the ſame kind with reſpect of a Shilling, which goes for the Whole, or for the Unit.

Tho' I have explain'd to you the Fractions in this ſenſe, yet you may conceive them in another ſenſe, which is equivalent to the firſt. Inſtead then of ſaying for Example that the Fraction AE, or $\frac{3}{4}$, repreſents 3 Quarters of a Unit, you may ſay it repreſents the fourth of three Units: For if you take AF triple of the Unit AB, you



will

will find that the Fraction AE, or $\frac{3}{4}$ is the fourth part of AF, or of three Units.

From whence it follows that in a Fraction the Denominator ought always to be confidered as a Divifor, and the Numerator as the Dividend: So that if the whole be confidered as a Pound, the Fraction $\frac{3}{4}$ fignifies three Pound to be divided by 4, which being impoffible, the three Pound muft be reduc'd into Shillings, by multiplying them by 20, to have in their place 60 Shillings, which being divided by 4, you have 15 Shillings or $\frac{15}{20}$ for the value of $\frac{3}{4}$ of a Pound, which is call'd *the Valuation of a Fraction,* where you fee that to make this Valuation you muft multiply the Numerator of the propos'd Fraction by the Number of the immediately lower kinds of the Integer, as by 20 if 'tis a Fraction of a Pound, or by 12 if 'tis the Fraction of a Shilling, and divide the Product by the Denominator.

By this you fee that Shillings are Fractions of the Pound, and that Pence are Fractions of a Shilling, and confequently they are the *Fractions of the Fraction* of the Pound, as Feet are of the Fathom, but Inches are the *Fractions of the Fraction of the Fraction* of the Fathom, and fo on.

It is again evident, that the Numerator and the Denominator of a Fraction, being multiplied or divided each by one and the fame Number, the Terms of the Fraction are chang'd, but its value does not change; which occafions the new Fraction proceeding from Multiplication or Divifion to be call'd *equivalent Fraction,* or *equal Fraction,* and alfo *fimilar Fraction.* Thus by multiplying by 3 the Numerator and the Denominator of this Fraction $\frac{2}{4}$, which is reprefented by the line AD, with refpect of the Unit AB, you have this equivalent Fraction $\frac{6}{12}$, becaufe its Numerator and its Denominator being equimultiple of the Numerator and Denominator of the propos'd Fraction are in the fame Ratio: And in like manner if of the fame Fraction $\frac{2}{4}$, each Term be divided by 2, you have this equal Fraction $\frac{1}{2}$.

By this it will be eafy to reduce a propos'd Fraction into lefs terms when it can be done, namely by dividing the Numerator and Denominator by one and the fame Number, which is call'd *Common Meafure.* The Bufinefs then is to find the greateft common meafure, or greateft Number which will exactly divide two others, to reduce by means of this number a Fraction into the leaft terms, it can be reduced. When the two Numbers or *Terms* which compofe the Fraction, are very little, 'tis eafy to difcover the greateft common Meafure: But becaufe it does

does not readily appear when the Terms of the Fractions are great Numbers, take this Method which never fails, when the thing is possible.

Of two propos'd Numbers, the greatest common Measure whereof is requir'd, substract the less from the greater, and after having left the greater, compare again the remainder with the other number, to substract the less from the greater, and continue thus till there remains twice one and the same Number, which will be the greatest common measure requir'd.

If there be propos'd for Example this Fraction $\frac{27}{36}$ whereof the two Terms are 27 and 36: After having written 27 under 36, substract 27 from 36, and write the Remainder 9 underneath: Leave 36, and because 9, is less than 27, you must substract it from 27, and you must write the remainder 18 underneath. Leave 27, and because 9 is less than 18, substract it from 18, and write the remainder 9 underneath. Then because there remains the same Number 9 twice, this Number 9 will be the greatest of all those which can possibly divide 27 and 36: For since 9 being substracted from 18, there still remains 9 'tis a sign that 9 was compriz'd a certain number of times in 18, and consequently in another Number compos'd of 9 and 18, namely in 27, and again in another Number compos'd of 27 and 9, that is to say in 36. If then you divide by 9 the the Numerator and Denominator of the propos'd Fraction $\frac{27}{36}$, you will have this lower and equivalent Fraction $\frac{3}{4}$.

$$\begin{array}{r} 36 \\ 27 \\ \hline 9 \\ \hline 18 \\ \hline 9 \end{array}$$

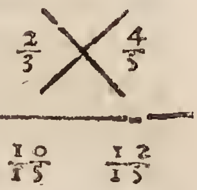
But this Operation may be abridg'd by Division, namely by dividing the greatest of the two propos'd Numbers, by the least, as in this Example, 36 by 27, and without minding the Quotient 1, by dividing the Number 27, which serv'd for the Divisor, by the remainder 9 of the Division, and by continuing in this manner till there remains nothing, and the last Divisor, which is here 9, will be the greatest common measure requir'd: So that if for this greatest common measure you find 1, which does not at all divide any thing, that is to say, which gives a Quotient equal to the Dividend, it will appear that the propos'd Fraction cannot be brought down, being it self in the lowest terms.

$$\begin{array}{rl} 36 & \\ 27 & (\ 1 \\ \hline 9 & (\ 3 \\ \hline 0 & \end{array}$$

It will be also easy to reduce two Fractions of a different Species into two others of the same Denomination, namely by multiplying each Fraction by the Denominator of

the other, for thus you will have two other Fractions equivalent to two propos'd ones, and of the same Denomination with each other, because the reciprocal Multiplication of two Numbers produces one and the same Number.

Let for Example these two Fractions of different kinds be propos'd $\frac{2}{3}$ and $\frac{4}{5}$, to be reduc'd into the same Denomination. After having written them over against each other, as you see here, multiply the first $\frac{2}{3}$ by the Denominator 5 of the other, and reciprocally the second $\frac{4}{5}$ by the Denominator 3 of the other, to have in their place these two other Fractions of the same kind $\frac{10}{15}$, $\frac{12}{15}$, which serves for Addition and Substraction, and even for Division of Fractions, and again to find the greatest of two given Fractions.



This Method may be applied to more than two Fractions, but you will have sooner done by following this other Method which is general, and which like the preceding, carries with it its own Demonstration.

Seek out a Number which is divisible by each Denominator of the propos'd Fractions, which will be found by multiplying together all the Denominators of the Fractions, and this Number so found will be the common Denominator of the Fractions requir'd, the Numerators whereof are found by dividing the common Denominator by that of the Fraction which you wou'd change, and by multiplying the Quotient by the Numerator of the same Fraction.

Thus if you are to reduce into the same Denomination these three Fractions of a different kind $\frac{2}{3}$, $\frac{3}{4}$, $\frac{3}{5}$, you must multiply together the three Denominators 3, 4, 5, and their Product 60 must be taken for the common Denominator of the three Fractions requir'd, to the end that you may take the two thirds of 'em, which is 40, the three fourths which is 45, and the three fifths which are 36, so that these three parts 40, 45, 36, will be the Numerators of the three Fractions requir'd, which consequently will be $\frac{40}{60}$, $\frac{45}{60}$, $\frac{36}{60}$, which will represent 40 Pence, 45 Pence, and 36 Pence, if the propos'd Fractions are of a Crown, which is in value 60 Pence. There are several Abridgments, which Practice and Theory will teach you.

PROB-

PROBLEM I.

Addition of Fractions.

IT is evident that to add ſeveral Fractions together of the ſame Denomination, you need only add together all the Numerators, and you'll have the Numerator of a Fraction, which having the ſame Denominator as that of the given Fractions, will be their Sum. Thus the Sum of theſe two Fractions of the ſame kind $\frac{2}{7}$, $\frac{3}{7}$, is $\frac{5}{7}$, and the Sum of theſe three $\frac{1}{9}$, $\frac{2}{9}$, $\frac{4}{9}$, is $\frac{7}{9}$, ſo of the reſt.

But if the propos'd Fractions be not of the ſame Denomination, they muſt be reduc'd into the ſame Denomination, then added, as was juſt now taught. Thus the Sum of theſe two Fractions $\frac{2}{7}$, $\frac{3}{5}$, or $\frac{10}{35}$, $\frac{21}{35}$, is $\frac{31}{35}$, and the Sum of theſe three $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, or $\frac{40-45-36}{60}$, is $\frac{121}{60}$, or $2\frac{1}{60}$.

If you are to add a whole Number and a Fraction, make of this whole Number an improper Fraction, by putting 1 underneath for a Denominator, then add theſe two Fractions as was juſt now taught. Thus to add 2 to $\frac{2}{3}$, make of the whole Number 2 this improper Fraction, $\frac{2}{1}$, and you will find that the Sum of theſe two Fractions, $\frac{2}{1}$, $\frac{2}{3}$, or $\frac{6}{3}$ $\frac{2}{3}$, is $\frac{8}{3}$.

When you are to add together ſeveral mixt Numbers you muſt write the Integers under the Integers, and the Fractions under the Fractions, and begin towards the right hand to add the Fractions, and let as many Integers as ſhall be found in the Sum of the Fractions be carried to the Integers which are at the left hand, as in compound Addition, and as you ſee in this

EXAMPLE.

A Draper has 3 Remnants of Stuff, the firſt of which contains $\frac{2}{3}$, the ſecond 6 Ells $\frac{3}{4}$, and the third 8 Ells $\frac{3}{8}$.

$$\begin{array}{r} 4\ \frac{2}{3} \\ 6\ \frac{3}{4} \\ 8\ \frac{3}{8} \\ \hline 20\ \frac{1}{24} \end{array}$$

To find how much all theſe Remnants make together, you will firſt find that the Sum of the three Fractions $\frac{2}{3}$, $\frac{3}{4}$, $\frac{3}{8}$, is $\frac{49}{24}$, which is 2 Ells and $\frac{1}{24}$, wherefore you muſt write $\frac{1}{24}$ under the line, and you muſt carry 2 Integers which being added to the Integers on the left hand, it will appear that the Sum of theſe three Remnants is 20 Ells and $\frac{1}{24}$.

PROB.

PROBLEM II.

Substraction of Fractions.

IT is also evident that to substract a Fraction from a greater of the same Denomination, you need only substract the least Numerator from the greater, to have the Numerator of a Fraction, which having the same Denominator as that of the propos'd Fractions will be their Difference. Thus the Difference of these two Fractions, $\frac{2}{7}$, $\frac{5}{7}$, is $\frac{3}{7}$, and the Difference of these two $\frac{2}{9}$, $\frac{7}{9}$, is $\frac{5}{9}$.

But if the two propos'd Fractions are not of the same Denomination, they must be reduc'd into two others of the same Denomination, the Difference whereof will be found as was just now taught. Thus the Difference of these two Fractions, $\frac{2}{3}$, $\frac{4}{5}$, or $\frac{10}{15}$, $\frac{12}{15}$, is $\frac{2}{15}$, and the Difference of these two $\frac{2}{7}$, $\frac{3}{5}$, or $\frac{10}{35}\frac{21}{35}$ is $\frac{11}{35}$.

If you be to substract a Fraction from a whole Number, make of this whole Number an improper Fraction, by making 1 its Denominator, then substract as has been taught. Thus $\frac{2}{5}$ subducted from 2, or from $\frac{2}{1}$, or from $\frac{10}{5}$, there remains $\frac{8}{5}$, or $1\frac{3}{5}$.

When you are to substract a whole Number with a Fraction, from a whole Number with another Fraction, you must write the whole Number under the whole Number, and the Fraction under the Fraction, and begin by the Substraction of the Fractions, borrowing an Unit from the next whole Number on the left hand, in case that the Substraction cannot be done; as in Compound Substraction, and as you see in this

EXAMPLE.

A Person cuts 2 Ells and $\frac{1}{2}$, off a Piece of Stuff; which contain'd 18 Ells and $\frac{3}{8}$, and he wou'd know what remains of the Piece. For this end I write $2\frac{1}{2}$ under $18\frac{3}{8}$, and I say $\frac{1}{2}$ from $\frac{3}{8}$, or $\frac{4}{8}$ from $\frac{3}{8}$ I cannot, I borrow 1, which is $\frac{8}{8}$, and which with $\frac{3}{8}$, makes $\frac{11}{8}$, from whence substracting $\frac{4}{8}$, there remains $\frac{7}{8}$, which I write under the line, and I retain 1, which with 2 makes 3, which being substracted from 18, there remains 15, I write it below, so that the Remainder will be 15 Ells and $\frac{7}{8}$.

$$\begin{array}{r} 18\ \frac{3}{8} \\ 2\ \frac{1}{2} \\ \hline 15\ \frac{7}{8} \end{array}$$

PROB.

PROBLEM III.

Multiplication of Fractions.

FIrst if you are to multiply a Fraction by a Whole Number, it is evident that there is nothing to do but to multiply the Numerator of the given Fraction, by the given Whole Number, and retain the same Denominator. Thus in multiplying the Fraction $\frac{2}{7}$, by the Whole Number 3, the Product is $\frac{6}{7}$, because the Triple of $\frac{2}{7}$ is $\frac{6}{7}$.

But to multiply a Fraction by another Fraction, you must multiply the Numerator by the Numerator, and the Denominator by the Denominator, for the Numerator and the Denominator of the third Fraction, which will be the Product of the two given Fractions. Thus it will appear, that the Product of these two Fractions $\frac{2}{3}$, $\frac{4}{5}$, is $\frac{8}{15}$, which wou'd be only $\frac{8}{3}$, if instead of $\frac{4}{5}$, you had the whole Number 4 but because instead of 4, you have $\frac{4}{5}$, that is to say, the fifth Part of 4, when you have multiplied $\frac{2}{3}$ by 4, you have $\frac{8}{3}$, of which you must again take the fifth Part, that is to say, the 8 which is divided by 3, ought to be again divided by 5, and consequently by 15, because the fifth Part of a third is a fifteenth. Or the Product wou'd be $\frac{8}{5}$, if instead of $\frac{2}{3}$, you had the whole Number 2, but because instead of 2, you have $\frac{2}{3}$, that is to say, the third Part of 2, when you have multiplied $\frac{4}{5}$ by 2, you have $\frac{8}{5}$, of which you must again take the third Part, that is to say, the 8, which is divided by 5, ought to be again divided by 3, and consequently by 15, because the third of a fifth Part is a Fifteenth.

If you are to multiply a Whole Number and a Fraction by another Fraction, you must add the Whole Number to its Fraction, and you must multiply the Sum by the other Fraction, as you shall see in this

EXAMPLE.

If an Ell of any Stuff is worth 12 $\frac{1}{2}$ *s.* and it is requir'd how much $\frac{3}{4}$ Ell of the same Stuff will cost; having added 12 to $\frac{1}{2}$, you have $\frac{25}{2}$, which being multiplied by $\frac{3}{4}$, there produce $\frac{75}{8}$ which is $9\frac{3}{8}$ *s.* for the value of $\frac{3}{4}$ of an Ell.

If you are to multiply a Whole Number and a Fraction by a Whole Number, you must first multiply the Fraction

Fraction by this Whole Number, by retaining as many Units as you find Integers in the Product in case this Product be an improper Fraction. Then multiply by the same Whole Number, the Whole Number of the Fraction, and add to the Product the Units retain'd.

EXAMPLE.

I wou'd know the Superficies of a Looking-Glass, the Length whereof is 4 Feet, and the Breadth 2 Feet and $\frac{2}{3}$. I multiply first $\frac{2}{3}$, by 4 there results $\frac{8}{3}$, or $2\frac{2}{3}$, I put $\frac{2}{3}$ down, and retain 2. I multiply afterwards 2 by the same 4, and to the Product 8, I add 2, which I retain'd, and write the Sum 10 under the line, so that the Product will be 10 square Feet, and $\frac{2}{3}$, which is equivalent to 96 Square Inches for the Superficies requir'd.

$$\begin{array}{r} 2\,\frac{2}{3} \\ 4 \\ \hline 10\,\frac{2}{3} \end{array}$$

Lastly, to multiply a whole Number and a Fraction by a whole Number and a Fraction, add each whole Number to its Fraction, and you'll have two improper Fractions, which must be multiplied together, as has been taught and as you shall see in this

EXAMPLE.

A Garden made in a Rectangular Form contains 32 Perches and $\frac{1}{2}$ in Length, and 18 Perches and $\frac{3}{4}$ in Breadth, and I wou'd know the Superficies of it. Multiply 32 and $\frac{1}{2}$, or $\frac{65}{2}$, by 18 $\frac{3}{4}$, or $\frac{75}{4}$, and you will have in the Product $\frac{1875}{8}$, or 234 Square Perches, and $\frac{3}{8}$ for the Superficies requir'd.

SCHOLIUM.

It is evident that when you multiply two Fractions together as $\frac{2}{3}$, and $\frac{4}{5}$, the Product $\frac{8}{15}$, is a Fraction of a Fraction, namely, the two thirds of four fifths, or which is the same thing, the four fifths of two thirds. So that, for Example, to know the Value of the $\frac{2}{3}$, of $\frac{3}{4}$ of $\frac{2}{5}$ of a Crown, there is nothing to do but to multiply these Fractions $\frac{2}{3}$, $\frac{3}{4}$, $\frac{2}{5}$, and you will have $\frac{12}{60}$, or 12 Pence, for this Fraction of a Fraction of a Fraction.

There are several Compendiums in Multiplication of Fractions, which are easy to be found, and of which consequently we shall not speak here. We shall only say, that to multiply a Fraction by a Number equal to its Denominator, the Product is a whole Number equal to the Nume-

Numerator of the Fraction. As the Product of the whole Number 4, and of this Fraction $\frac{3}{4}$ is the Numerator 3.

PROBLEM IV.

Division of Fractions.

To divide first a Fraction by a Whole Number, it is evident that there is nothing to do but to divide the Numerator of this Fraction by the whole Number, and retain the same Denominator, when the Numerator can be divided exactly by the whole Number; otherwise you must multiply the Denominator of the Fraction by the whole Number, and retain the same Numerator. Thus in dividing this Fraction $\frac{8}{9}$ by 4, the Quotient is $\frac{2}{9}$, it being certain that the fourth of $\frac{8}{9}$, is $\frac{2}{9}$, and in dividing $\frac{2}{3}$ by 5, the Quotient is $\frac{2}{15}$, for it is evident that the 2 which is divided by 3 by reason of $\frac{2}{3}$, and which ought to be divided by 5, ought to be divided by 3 times 5, or by 15, because the fifth Part of a third is a fifteenth.

To divide a Whole Number and a Fraction by a Whole Number, you must add the Fraction to its whole Number, to make an improper Fraction of it, which may be divided by the other Number, as was just now taught.

Thus to find the sixth Part of $3\frac{1}{2}$ *s.* that is to say, to divide 3 and $\frac{1}{2}$, or $\frac{7}{2}$ by 6, in multiplying 2 by 6, you will have $\frac{7}{12}$, which is 7 *d.* for the sixth Part requir'd.

To divide a Whole Number by a Fraction, you must multiply the whole Number by the Denominator of the Fraction, and divide the Product by the Numerator of the same Fraction. Thus to divide 5 by $\frac{2}{3}$, you must multiply 5 by 3, and divide the Product by 2, the Quotient will be $\frac{15}{2}$, or $7\frac{1}{2}$; because if you were to divide 5 by 2 the Quotient wou'd be $\frac{5}{2}$, but as you are to divide it by the third of 5, the Quotient will be three times greater, and consequently $\frac{15}{2}$, it being certain that the Quotient is greater proportionably as the Divisor is less, because the Divisor being less, is oftner contain'd in the Dividend.

To divide a Whole Number by a whole Number and a Fraction, you must add this Fraction to its Whole Number, to have an improper Fraction, by which you may divide the first whole Number given, as was just now taught. Thus to know how many Pieces each of $3\frac{1}{2}$ *s.* in

in 84 *s.* you must divide 84 by $3\frac{1}{2}$, or by $\frac{7}{2}$, and you will find 24 for the Number of Pieces contain'd in 84 *s.*

To divide a Fraction by a Fraction, you must reduce these two Fractions into the same Denomination, if they are not so, and the two Fractions of the same Denomination will be to each other as their Numerators, by reason of their common Denominator, which may therefore be neglected. Thus instead of the two given Fractions you will have two whole Numbers, which being in the same Ratio as the Fractions, will have one and the same Quotient. If then under the whole Number which is the Numerator of the Dividend, you write the whole Number, which is the Numerator of the Divisor, in form of a Denominator, you will have a Fraction which will be the Quotient requir'd. Thus in dividing $\frac{2}{3}$ by $\frac{3}{7}$, or $\frac{14}{21}$ by $\frac{9}{21}$ or 14 by 9, the Quotient is $\frac{14}{9}$, or $1\frac{5}{14}$, which will be found also by multiplying the Fraction to be divided $\frac{2}{3}$ by $\frac{7}{3}$, which is the inverse of the Divisor $\frac{3}{7}$, because Multiplication is the contrary of Division.

Lastly to divide a whole Number and a Fraction by another whole Number and a Fraction, you must add each whole Number to its Fraction, and you will have two improper Fractions, then do as was just now taught, and as you see in this

EXAMPLE.

I wou'd know the Breadth of a Rectangular Hall, the Length whereof is 8 Fathoms and $\frac{2}{3}$, and the Superficies 49 Square Fathoms and $\frac{3}{4}$. Divide 49 $\frac{3}{4}$, or $\frac{199}{4}$ by $8\frac{2}{3}$ or $\frac{26}{3}$, that is to say, by reducing these two improper Fractions into the same Denomination $\frac{597}{12}$ by $\frac{104}{12}$ or 597 by 104, and the Quotient will be $\frac{597}{104}$, which is 5 Fathoms and $\frac{77}{104}$ for the Breadth requir'd.

PROBLEM V.

To extract the Square Root of a Fraction.

As a Fraction multiplied by it self produces another less Fraction for its Square, whereof the Numerator and Denominator are the Squares of the Numerator and Denominator of its Side, or of its Square Root; it follows that to extract the Square Root of a Fraction, there needs no more than to take the Square Root of the Numerator,

and of the Denominator, for the Numerator and Denominator of a Fraction, which is to be the Square Root of the propos'd one. Thus the Square Root of this Fraction $\frac{25}{144}$ is $\frac{5}{12}$.

As every Number is not a Square, so every Fraction has not its exact square Root, but before that is determin'd the Fraction must be reduc'd into less Terms. Thus the Square Root of this Fraction $\frac{18}{50}$, or $\frac{9}{25}$ is $\frac{3}{5}$.

But this Square Root, when there is one, may be known without bringing down the Fraction, namely, by multiplying together the Numerator and Denominator of the propos'd Fraction, as here 18 and 50, and by taking the square Root of the Product 900, which is 30, which may be taken for the Denominator of the Root requir'd, and then take for its Numerator, that of the propos'd Fraction. Thus the Square Root of $\frac{18}{50}$, will be $\frac{18}{30}$, or $\frac{3}{5}$. Or you may take this Square Root 30 for the Numerator of the Root requir'd, and then take for its Denominator that of the propos'd Fraction. Thus the Square Root of the same Fraction $\frac{18}{50}$ will be $\frac{30}{50}$ or $\frac{3}{5}$, as before.

PROBLEM VI.

To extract the Cube Root of a Fraction.

SInce a Fraction multiplied by its Square produces another less Fraction for its Cube, whose Numerator and Denominator are the Cubes of the Numerator and Denominator of its Side, or of its Cube Root; it follows that to extract the Cube Root of a Fraction, there is nothing to do but to take the Cube Root of the Numerator and Denominator, for the Numerator and Denominator of a Fraction, which will be the Cube Root of the propos'd one. Thus the Cube Root of this Fraction $\frac{8}{125}$ is $\frac{2}{5}$.

As every Number is not a perfect Cube, so every Fraction hath not its precise Cube Root, but before you are sure of it, the Fraction must be reduc'd into the least Terms. Thus the Cube Root of this Fraction $\frac{54}{128}$ or $\frac{27}{64}$, is $\frac{3}{4}$.

But this Cube Root, when there is one, may be known without reducing the Fraction lower, namely by multiplying the Numerator by the Square of the Denominator, as here 54 by the Square 16384 of the Denominator 128, and by taking the Cube Root of the Product 884736, which is 96, and must be taken for the Numerator of the Root requir'd, and then the Denominator will be the same as that of the given Fraction. Thus the Cube Root of $\frac{54}{128}$ will

will be $\frac{96}{128}$ or $\frac{3}{4}$. Or else by multiplying the Denominator 128 by the Square 2916 of the Numerator 54, and extracting the Cube Root of the Product 373248, that is 72, which must be taken for the Denominator of the Root requir'd, and then the Numerator will be the same as that of the given Fraction. Thus the Cube Root of the same Fraction $\frac{54}{128}$ will be $\frac{54}{72}$ or $\frac{3}{4}$ as before.

SCHOLIUM.

If the propos'd Fraction has not such a Root as is requir'd, you will find it so much the nearer, by adding at pleasure an equal Number of Cyphers, to its Numerator and Denominator, to have an equivalent Fraction, whose Square or Cubic Root you can take, as has been taught. Thus the Square Root of $\frac{2}{3}$, or $\frac{20000}{30000}$, is $\frac{141}{173}$, and its Cube Root is $\frac{29}{31}$.

PART III.

Of the Rules of Proportion.

THE *Rule of Proportion* particularly so call'd, and more commonly the *Rule of Three*, but for its Excellency the *Golden Rule*, is that which teaches us how to find a Number which is a fourth Proportional to three given Numbers: And in general we call *Rules of Proportion* all those which are perform'd by the Rule of three, which may be *Direct* or *Inverse*, and both may be *Simple* or *Compound*.

PROBLEM I.

To resolve a Question by the Single Direct Rule of Three.

THE Direct Single Rule of Three teaches to find to three given Numbers a fourth Number, which may be greater or less than the second in proportion as the third is greater or less than the first, so that the first is to the second, as the third is to the fourth, which is found by multiplying together the two last of the three given Num-

bers, and by dividing the Product by the first; for in multiplying together the two last, that is to say, the second and third, which are the two Means of the four Proportionals, you have the Product of the two Extreams *per* 16. 6. wherefore by dividing this Product by one of the two extreams, as by the first, which is known, you have the other extream, or the fourth, which consequently will be known.

In this Rule of Three, the first and third given Number must always be of the same Nature, as likewise the second and the fourth, because the first is a certain Number of things, and the Second their Value, and in like manner the third is another Number of such things, and the fourth their Value, which will be found, as was just now taught, and as you'll see in the following Examples.

EXAMPLE I.

If 36 Men dispatch 484 Fathoms of Work in a Day, I demand how much 144 Men will perform. Having dis-

Men.	*Fathoms.*	*Men.*
36	484	144

```
 484
 144
1936
1936
484
69696 ( 1936 Fathom.
36
 336
 36
  129
   36
   216
    36
    00
```

pos'd the three given Terms as you see here, and put the least of the two last under the greater, that is to say 144 under 484, multiply them together, and divide the Product 69696

69696 by the first 36, the Quotient will give 1936 Fathoms which 144 Men ought to dispatch in a Day, supposing as before that 36 Men dispatch'd 484 in a Day.

The Proof of the Single Direct Rule of Three.

The Proof of the single direct Rule of Three, is made by another single direct Rule of Three, as in this Exam-

```
Men.    Fathoms.    Men.

144     1936        36
          36
        -----
        11616
        5808
        -----
        69696
          144  (484 Fathoms.
        -----
         1209
          144
        -----
           576
           144
          -----
           000
```

ple, having found that when 36 Men did 484 Fathoms of work in a Day, 144 Men ought to do 1936, you must say, if 144 Men do 1936 Fathoms of Work in a Day, how many ought 36 Men to do? And you ought to have 484 Fathoms for the Proof.

If there had remain'd any thing of the Division, which is done in the first Rule of three, it shou'd be added to the Product of the Multiplication which is made in the Proof.

EXAMPLE 2.

If 18 Fathoms of Brick-work cost 68 *l.* 5 *s.* I demand how much 136 Fathoms of the same Brick-work will cost. Having put 136 over 68 as you see here multiply 68 *l.* 5 *s.* by 136, and divide the Product 9282 *l.* by the first Term 18, the Quotient will be 515 *l.* 13 *s.* $\frac{6}{18}$ which is 4*d.*

Fathoms.		Fathoms.
18	136 68 *l.* 5 *s.*	136

```
 136
  68 l. 5 s.
 ----
1088
816
  34 for 5 s.
 ----
9282 l.
18              (515 l. 13 s. 6/18.
 ----
 28
 18
 ----
102
 18
 --
 12
 20
 ----
240 s.
 18
 ----
 60
 18
 --
  6
```

the Price of 146 Fathoms. This may be proved as before.

EXAMPLE 3.

If 4 *l.* 3 *s.* 3 *d.* give 2 *l.* 5 *s.* 6 *d.* Profit in one Year, I demand how much 2 *l.* 15 *s.* 6 *d.* will give.

```
4 l.  3 s.  3 d.    2 l.  5 s.  6 d.    2 l.  15 s.  6 d.
20                                      20
--                                      --
83 s.                                   55 s.
12                                      12
--                                      --
166                                     110
833                                     556
----                                    ----
999 d.                                  666 d.
9                                       9
----                                    ----
111                                     74              74
```

```
        74
         2 l.  5 s.  6 d.
      ----------------------
      148 l.
       18 l.  10 s. for 5 s.
              37 s. for 6 d.
      ----------------------
111 ) 168 l.  7 s.
      111            (1 l. 10 s. 4 d.
      ----------------------
       57
        20
      ------
111 ) 1147  ( 10 s.
      111
      ---
        37
        12
      ------
        74
       37
      ------
111 ) 444 ( 4 d.
      111
      ------
      000
```

To resolve this Question methodically and easily, reduce the first Term 4 *l.* 3 *s.* 3 *d.* and one of the two others, for example, the third 2 *l.* 15 *s.* 6 *d.* into the lowest Denomination, namely, into Pence, and instead of the first Term 4 *l.* 3 *s.* 3 *d.* you will have 999 Pence, and instead of the third 2 *l.* 15 *s.* 6 *d.* you will have 666 Pence: And to have smaller Numbers, divide the 999 and the 666 by one and the same Number, if there is one, for Example by and 9, you will have in their place these two less 111, 74, being in the same Ratio will give the same fourth Proportional. By using then these two Numbers 111, 74, which may be again brought lower by dividing each by 37, you will find 1 *l.* 10 *s.* 4 *d.* for the fourth Proportional requir'd, that is to say, for the Profit of 2 *l.* 15 *s.* 6 *d.*

EXAMPLE 4.

If 6 Ells and $\frac{2}{3}$ of Cloth cost 12 *l.* I demand how much 8 Ells and $\frac{3}{4}$ will cost of the same Cloth. You must add each Fraction to its Integer, and instead of $6\frac{2}{3}$ you will have $\frac{20}{3}$, and instead of $8\frac{3}{4}$, you will have $\frac{35}{4}$. After that, you must reduce these two improper Fractions $\frac{20}{3}$, $\frac{35}{4}$, into these two others of the same Denomination $\frac{80}{12}$, $\frac{105}{12}$, then neglect the common Denominator 12, and say if 80 Ells are worth 12 *l.* how much will 105 Ells be worth, and you will find 15 *l.* 15 *s.* for the Value of 8 Ells and $\frac{3}{4}$.

E.	*L.*	*E.*
$6\frac{2}{3}$	12	$8\frac{3}{4}$
$\frac{20}{3}$		$\frac{35}{4}$
$\frac{80}{12}$		$\frac{105}{12}$

$$
\begin{array}{rrr}
 & 105 & \\
80 \;. & 12 & :\; 105 \\
\hline
 & 210 & \\
 & 105 & \\
\hline
 & 1260 & \\
 & 80 & \\
\hline
 & 460 & \\
 & 80 & (15\,l.\ 15\,s. \\
\hline
 & 60 & \\
 & 20\,s. & \\
\hline
 & 1200\,s. & \\
 & 80 & \\
\hline
 & 400 & \\
 & 80 & \\
\hline
 & 00 &
\end{array}
$$

PROB.

PROBLEM. II.

To resolve a Question by the Single Indirect Rule of Three.

THE Single Indirect or *Inverse* Rule of Three teaches to find to three given Numbers a fourth Number, less or greater than the second, and of the same Nature, in proportion as the third is greater or less than the first, and of the same Nature likewise: So that the first Number be to the third, as the fourth is to the second, and consequently the third to the first, as the second to the fourth, or the third to the second, as the first to the fourth, which will be consequently found by multiplying together the first and the second, and by dividing their Product by the third, which is contrary to what was done in the preceding Problem, because this Rule is contrary to the preceding, where the fourth Term proceeded from more to more, or less to less; whereas in this the fourth unknown Term ought to go from more to less, or from less to more, that is to say, that if the third Term be great with respect to the first, the fourth will be little with respect to the second, and that if the third Term be little with respect to the first, the fourth will be great with respect to the second, as you shall see in the following Examples.

EXAMPLE I.

If out of my Allowance I can spend 60 *d.* a Day for 18 Months, I wou'd know how much I may spend a Day with the same Allowance during 24 Months. Say, if 18 Months will supply me with 60 *d.* a Day, how much will 24 Months supply me? The Mind easily judges that 24 Months,

Months.	*Pence.*	*Months.*
18	60	24
	18	
	1080	
	24 (45 *d.*	
	120	
	24	
	00	

which

which are more than 18 Months, will ſupply leſs, that is to ſay, I ought to ſpend leſs a Day, if I wou'd have my Money laſt 24 Months, and conſequently this Rule of Three is indirect. Having then diſpo'd the three given Numbers, as they are delivered in the Queſtion, and as you ſee here, I multiply together the two firſt 60, 18, and I divide their Product 1080 by the third 24, and the Quotient gives me 45 *d.* for the Money that I have to ſpend a Day during 24 Months.

The Proof of the Simple Indirect Rule of Three.

The Simple Indirect Rule of three is proved by another Simple Indirect Rule of Three, as in this Example, having found that when 18 Months can furniſh 60 *d.* a Day, 24 Months can furniſh but 45 *d.* you muſt ſay if 24 Months do furniſh 45 *d. per* Day how much will 18 Months furniſh?

Months.	*Pence.*	*Months.*
24	45	18
	24	
	180	
	90	
	1080	
	18 (60 *l.*	
	000	

and there ought to come 60 *d.* for the Proof, taking care as before, that you always add to the Product in Multiplication what remain'd in the Diviſion, made in the firſt Rule of Three.

EXAMPLE 2.

If to pave a Hall there muſt be 5400 Bricks which are 6 Inches each way, I demand how many Bricks which are 4 Inches each way, will pave the ſame Hall. It ſeems at firſt ſight that the given Terms muſt be diſpos'd as you ſee here: But as ſuch Polygons are to each other as the Squares of their homologous Sides, *per* 20. 6. inſtead of

Inches.	*Bricks.*	*Inches.*
6	5400	4

the

the two extream Terms 6, 4, put their Squares 36, 16, ſo that the three given Terms will be ſuch as you ſee here. Multiplying then the two firſt Terms 36, 5400, and dividing their Product 194400 by the third 16, you

Inches.	*Bricks.*	*Inches.*
36	5400	16

```
 5400
   36
 ----
32400
16200
-----
194400
16        (12150 Bricks.
------
 34
 16
 --
  24
  16
  --
   80
   16
   --
   000
```

will have 12150 in the Quotient, for the Number of the Bricks requiſite to pave the ſaid Hall, ſuppoſing them to be but 4 Inches each way, it being evident that the leſs they are, the more there muſt be of 'em, and that thus the propos'd Queſtion ought to be reſolv'd by the Inverſe Rule of Three; and the Proof made as we have already ſaid by another Inverſe Rule of three, *&c.*

EXAMPLE 3.

There is Proviſion enough in a Caſtle to ſerve a Garriſon of 200 Men for a Year, or 365 Days, and upon the report of the Enemy's approach, the Garriſon was augmented to 500 Men. I demand for how many Days will the Proviſion ſerve theſe 500 Men. You muſt ſay if 200 Men can be maintain'd 365 Days, how many Days may 500 Men be maintain'd. To ſhorten the Calculation, cut off from the firſt Term 200, and from the third 500, two Cyphers, which is the ſame thing as if you divided 'em each by 100, and in their place you will have theſe two others

Men.	*Days.*	*Men.*
200	365	500

```
 365
   2
 ---
 730
   5    (146 Days.
 ---
  23
   5
 ---
  30
   5
 ---
   0
```

others, 2, 5, which being in the ſame Ratio, will give the ſame Quotient. Multiplying then 365 by 2, and dividing the Product 730 by 5, you will have 146 in the Quotient, for the Number of Days requir'd.

EXAMPLE 4.

I demand how many Ells of Cloth of an Ell and a Quarter broad, will line a piece of Tapiſtry 10 Ells long, and $3\frac{1}{2}$ broad. Say if $3\frac{1}{2}$ in breadth give 10 in length, how many will $1\frac{1}{4}$ in breadth give.

Having then diſpos'd the given Terms as you ſee here, you muſt reduce the breadth $3\frac{1}{2}$ into this improper Fraction $\frac{7}{2}$, and the breadth $1\frac{1}{4}$, into this other improper

Breadth.	*Length.*	*Breadth.*
$3\frac{1}{2}$	10	$1\frac{1}{4}$

Fraction $\frac{5}{4}$, and theſe two improper Fractions $\frac{7}{2}$, $\frac{5}{4}$, being reduc'd into theſe two of the ſame Denomination $\frac{14}{4}$, $\frac{5}{4}$, neglect the common Denominator 4, and write the three Terms in Integers, as you ſee here. Multiplying then together the two firſt 14, 10, and dividing the Product 140, by the third 5. the Quotient will give 28 Ells of Cloth, requiſite to line the piece of Tapiſtry, as is evident by 14. 6.

```
14, 10, 5
10
---
140
  5  (28 Ells.
---
 40
  5
---
  0
```

PROB.

PROBLEM III.

To resolve a Question by the Compound Direct Rule of Three.

THE Compound Direct Rule of Three teaches to find to five given Numbers a sixth Number, which is to the third as the Product of the two last to the Product of the two first. Wherefore to find this sixth, you must reduce the five given terms to three; namely by putting in the place of the two first their Product, and likewise in the place of the two last their Product, as you shall see in this

EXAMPLE.

If a piece of Cloth 42 Feet long, and 3 broad, cost 36 *l.* I demand how much another piece of such Cloth 36 Feet

Long.	*Broad.*	*Pounds.*	*Long.*	*Broad.*
42.	3.	63.	36.	4.

126 *Product.*   144 *Product.*

```
 144
  63
 ----
 432
864
 ----
9072
126   (72 Quotient.
 ----
 252
 126
 ----
 000
```

long, and 4 Feet broad will cost. Having put in the place of the two first Terms 42 3, their Product 126, and in the place of the two last 36, 4, their Product 144, which may be done, because the first Product 126, represents the Surface of the first piece of Cloth, and likewise the second Product 144 represents the Surface of the second piece of Cloth, you must multiply together the two last terms 63, 144, and you must divide their Product 9072 by the first 126, and you will have in the Quotient 72 *l.* for the Price of the second Piece of Cloth.

SCHO-

SCHOLIUM.

This Rule is alſo call'd *Rule of Five*, by reaſon of the five given terms, of which it is compos'd, where you ſee that the firſt and fourth terms are of the ſame nature, as alſo the ſecond and fifth, which ought always to be ſo. As for the third term it is alſo always of the ſame nature as the ſixth which is requir'd.

It is alſo call'd *Double Rule*, becauſe it may be practic'd by a double direct Rule of three, by ſaying firſt, if 42 in length coſts 63 *l.* how much will 36 in length coſt? and you will find 54 *l.* then ſaying if 3 in breadth coſt 54 *l.* how much will 4 of breadth coſt? and you will find 72 *l.* as before. Or rather by ſaying firſt, if 3 in breadth give 63 *l.* how much will 4 in breadth give? and you will find 84 *l.* then ſaying if 42 in length give 84 *l.* how much will 36 in length give, and you will find 72 *l.* as before. But you will have ſooner done by following the firſt Method, or, which is the ſame thing, by multiplying together the three laſt Terms, and by dividing their Product by the Product of the two firſt, as you ſhall ſee in this other

EXAMPLE.

If 8 Men in 6 Days dig 24 Cubic Fathoms of Earth; I demand how many at the ſame rate 12 Men will dig in 3 Days. Having multiplied together the two firſt terms 8, 6, you

Men.	*Days.*	*Fathoms.*	*Men.*	*Days.*
8	6	24	12	3
6			3	
48 *Diviſor.*			36	
			24	
			144	
			72	
			864 *Product.*	
			48 (18 *Fathoms.*	
			384	
			48	
			00	

will

will have 48 for the Divisor; and if you multiply together the three last terms 24, 12, 3, you will have 864 for the Dividend, and the Quotient will give 18 Cubic Fathoms, which 12 Men will perform in 3 Days; this may be proved three different ways.

Proof of the Direct Rule of Five.

The Double direct Rule is proved by another Double direct Rule, which we shall perform three different ways, because each hath its use and difficulty.

First, you must say then, if 12 Men in 3 Days dig 18 Cubic Fathoms, how many will 8 Men dig in 6 Days?

Men.	*Days.*	*Fathoms.*	*Men.*	*Days.*
12	3	18	8	6
3			6	
36 *Divisor.*			48	
			18	
			384	
			48	
			864 *Product.*	
			36 (24 *Fathoms.*	
			144	
			36	
			00	

the answer ought to be 24 Fathoms as was suppos'd in the Example.

If there had remain'd any thing after the Division, in the first double Rule, it must have been added to the Product, which arises from the Multiplication of the three last Terms in its Proof.

Or you may say, if 8 Men in 6 Days dig 24 Cubic Fathoms, I demand how many Men there must be to dig 18 Cubic Fathoms 3 Days, you will find ~~12 Men~~ Since the terms of this Rule ought to be dispos'd according to the order of the preceding Example, and since the fourth is unknown, namely the number of Men requir'd, you must put the Letter x for this number of Men, and then the six terms will have this disposition, and by considering only the

the five first, you must seek out the sixth 18, as if it was unknown, by multiplying together the three last 24, x, 3,

Men.	*Days.*	*Fathoms.*	*Men.*	*Days.*	*Fathoms.*
8	6	24	x	3	18
6			3		
48 *Divisor.*			$3x$		
18			24		
384			$72x$ *Product.*		
48					
864					
72 (12 *Men.*					
144					
72					
00					

and by dividing their Product $72x$ by the Product 48 of the two first 8, 6, the Quotient will be $\frac{72x}{48}$, which being equal to the sixth term 18, you will find $x = 12$, for the number of Men requir''d. But to avoid the Fractions, multiply 48 by 18, and divide the Product 864 by 72, &c.

Or again say, if 8 Men in 6 Days dig up 24 Cubic Fathoms of Ground, I demand in how many Days 12 Men will dig up 18, and you shou'd find 3 Days. Since the Terms of this Rule ought to be dispos'd according to the

Men.	*Days.*	*Fathoms.*	*Men.*	*Days.*	*Fathoms.*
8	6	24	12	x	18
6			x		
48			$12x$		
18			24		
384			48		
48			24		
864			$288x$ *Product.*		
288 (3 *Days.*					
000					

order

order of the preceding Example, and that the fifth is unnown, namely the Number of Days requir'd, put the Letter x for this Number of Days, and then the six Terms

Men.	*Days.*	*Fathoms.*	*Men.*	*Days.*	*Fathoms.*
8	6	24	12	x	18

8	12
6	x
48 *Divisor.*	$12x$
18	24
384	48
48	24
864	$288x$ *Product.*
288 (3 *Days.*	
000	

will have this disposition, and considering only the first, search for the sixth 18, as if it was unknown, by multiplying the three last 24, 12, x, and by dividing their Product $288x$ by the Product 48 of the two first 8, 6, the Quotient will be $6x$, which being equal to the sixth term 18, you will find $x=3$ for the Number of Days requir'd: And to avoid the Fractions which may happen, multiply 48 by 18, and divide the Product 864 by 288, *&c.*

PROBLEM IV.

To resolve a Question by the Compound Indirect Rule of Three.

THE Compound Indirect or Inverse Rule of Three, teaches to find, in five given Numbers, a sixth, which is to the third, as the Product of the two first is to the Product of the two last. Wherefore to find this sixth, you must reduce these five given terms to three, namely by putting in the place of the two first their Product, and in like manner instead of the two last their Product, as you see in this

EXAMPLE.

If there muſt be 5400 Bricks, 6 Inches long, and 3 broad, to pave a Hall, I demand how many Bricks there

Long.	*Broad.*	*Bricks.*	*Long.*	*Broad.*
6	3	5400	9	4

$\underbrace{6 \quad 3}_{18\ \textit{Product.}}$ $\qquad$ $\underbrace{9 \quad 4}_{36\ \textit{Product.}}$

```
 18 Product.
 5400
 ----
 72
 90
 -----
 97200
 36     (2700 Bricks.
 -----
 252
 36
 -----
 0000
```

muſt there be 9 Inches long, and 4 broad, to pave the ſame Hall. Having put inſtead of the two firſt terms 6, 3, their Product 18, and inſtead of the two laſt 9, 4; their Product 36, which may be done, becauſe the firſt Product 18 repreſents the Surface of the firſt ſort of Bricks, and the ſecond 36 repreſents the Area of the ſecond ſort, then multiply together the two firſt terms 18, 5400, and divide their Product 97200 by the third and laſt 36, and you will have in the Quotient 2700 for the Number of Bricks requir'd.

SCHOLIUM.

This Rule is alſo call'd *Rule of Five*, by reaſon of the five given terms of which it is compos'd, where you ſee that the firſt and fourth terms are of the ſame Nature, as likewiſe the ſecond and fifth, which ought always to be ſo, for the third term it is alſo always of the ſame nature as the ſixth requir'd.

It is alſo call'd *Double Rule*, becauſe it may be practic'd by an Inverſe double Rule of three, by ſaying firſt, if 6 of length give 5400 Bricks, how many will 9 of length give? and you will find 3600 Bricks; then ſaying, if 3 of

of breadth give 3600 Bricks, how many will 4 of breadth give? and you will find 2700 Bricks as before. Or saying, if 3 of breadth gives 5400, how many will 4 of breadth give? and you will find 4050 Bricks; then saying if 6 of length give 4050 Bricks, how many will 9 of length give? and you will find 2700 Bricks, as before. But you will have sooner done by following the first Method, or which is the same thing, by multiplying together the three first terms, and by dividing their Product by the Product of the two last, as you see in this other

EXAMPLE.

It is suppos'd that 6000 Men which are in Garrison in a besieg'd place, may have each 15 Ounces of Bread a Day,

Men.	*Months.*	*Ounces.*	*Men.*	*Months.*
6000	4	15	5000	6
4			6	
24			30 *Divisor.*	
15				
120				
24				
360 *Product.*				
30 (12 *Ounces.*				
60				
30				
00				

out of the Magazine, during 4 Months, but the Seige being like to last longer, and supposing this Garrison to be reduc'd to 5000 Men, by the loss of 1000 Men, it is requir'd what may be given a Day to each Man, so that the same Quantity of Provision may last 6 Months: Say if 6000 Men in 4 Months have 15 Ounces of Bread each, how much may 5000 Men have for 6 Months? In this case you may abridge the calculation by cutting off 3 Cyphers from the first and fourth term, and finishing the rest, as we have said, and as you see here, where each Soldier is reduc'd to 12 Ounces of Bread a Day: This may be proved by another Compound indirect Rule of Three,

and

and that three different ways, by reaſoning in the ſame manner as in the preceding Problem.

Inſtead of the five terms which commonly happen in a Compound Rule of Three, there are ſometimes ſeven, and then it is call'd *Rule of Seven*, which may alſo be *Direct*, and *Indirect*, but may be reduc'd as the preceding ones into ſingle Rules of Three, namely by putting inſtead of the three firſt terms their Product, and in like manner inſtead of the three laſt terms their Product, as you ſee in the following Examples.

Example of the Direct Rule of Three.

If a Beam 12 Feet long, 3 broad, and two thick, weighs 1296 Pounds, I demand how much a Beam of the ſame Wood ſhou'd weigh, being 15 Feet long, 5 Feet broad and 1 Foot thick. Having diſpos'd theſe ſeven Terms as you ſee here, put in the place of the three firſt 12, 3, 2,

Lo.	*Bro.*	*Th.*	*Pounds.*	*Lo.*	*Br.*	*Th.*
12	3	2	1296	15	5	1

$\underbrace{12 \quad 3 \quad 2}$ 72 *Solid Product.* $\qquad$ $\underbrace{15 \quad 5 \quad 1}$ 75 *Solid Product.*

```
      75 Solid Product.
    1296
   -----
    6480
   9072
   -----
   97200
   72        ( 1350 Pounds.
   -----
    252
     72
   -----
    360
     72
   -----
    000
```

their ſolid Product 72, ſo call'd, becauſe it repreſents the ſolidity of a Beam, and inſtead of the three laſt, 15, 5, 1, their ſolid Product 75, and then the Rule of Seven will be reduc'd to theſe three terms 72, 1296, 75, whereof the two laſt being multiplied together, and their Product 97200 being divided by the firſt 72, the Quotient will give 1350 Pounds for the weight requir'd. This may be prov'd

prov'd by another direct Rule of Seven, saying, if a Beam 15 Feet long, 5 broad, and 1 thick weighs 1350 Pounds, how much will a Beam 12 Feet long, 3 Feet broad, and 2 thick weigh? and you will find that it weighs 1296 Pounds, as we suppos'd in the beginning.

Example of the Indirect Rule of Seven.

If to build a Wall, there must be 5400 Bricks, 6 Inches long, 3 broad, and 2 deep, I demand how many Bricks there must be, of 8 Inches long, 4 broad, and 3 deep, to build the same Wall. If you put instead of the three first

Lo. Br. Deep.	*Bricks.*	*Lo. Br. Deep.*
$\underbrace{6\quad 3\quad 2}_{36}$	5400	$\underbrace{8\quad 4\quad 3}_{96}$ *Divisor.*
	36	
	32400	
	16200	
	194400	
	96	(2025 *Bricks.*
	240	
	96	
	480	
	96	
	00	

terms, 6, 3, 2, their Product 36, and instead of the three last, 8, 4, 3, their Product 96, the Rule of Seven will be found reduc'd into these three terms 36, 5400, the two first whereof being multiplied together, and their Product 194400 being divided by the last 96, as you see here, the Quotient will give 2025 for the Number of Bricks requir'd

PROBLEM V.

To resolve a Question by the Rule of Fellowship.

THE Rule of Fellowship teaches to divide a given Number, which we will call *Principal Sum*, proportionally to several other given Numbers, which we will call *particular Disbursements*; which is done by the Direct Rule of Three repeated as many times as there are particular Dis-

burſements, namely by adding together all the particular Disburſements, to have their Sum, and ſaying, if the Sum of the particular Disburſements gives ſo much for the principal Sum, how much will each particular Disburſement give? So that each particular Disburſement muſt be multiplied by the principal Sum, and each Product divided by the Sum of the particular Disburſements to have in each Quotient the Number which agrees proportionally to each particular Disburſement, as is evident *per* 12. 5.

This Rule is call'd *Rule of Fellowſhip*, becauſe it ſerves chiefly in the Aſſociation which is made by ſeveral private Men to ſhare among them the common Gain, or the common Loſs, which holds the place in the principal Sum, according to the Money that each puts into the common Stock, for a certain time, which may be equal or different, ſo that this Rule may be *ſingle*, when the time is equal, and *compound* when the time is different, and then it is alſo call'd *Rule of Fellowſhip by Time*. We ſhall give an Example of both.

An Example of a Single Rule of Fellowſhip.

Three Captains plunder'd the Enemy of 1200 *l.* one with 24 Soldiers, the other with 36, and the third with 12: and it is demanded what each Captain ought to have

```
 1200            1200
   24              36
 ----            ----
 4800            7200
2400            3600
-----           -----
28800           43200
   72 ( 400        72 ( 600
-----           -----
 0000            0000

         1200
           12
         ----
         2400
        1200
        -----
        14400
           72 ( 200
        -----
         0000
```

for

for his part of 1200 *l.* in proportion to the Number of his Soldiers. For this end, multiply ſeparately the principal Sum 1200 by the Number of Soldiers of each Captain, namely by 24, 36, 12, and divide each Product 28800, 43200, 14400, by the Sum 72 of all the Soldiers, and the firſt Quotient is 400 *l.* the Captain's part who had 24 Soldiers, the ſecond Quotient is 600 *l.* for the Captain's part who had 36 Soldiers, and the third is 200 *l.* the Captain's part who had 12 Soldiers. This may be proved by adding together theſe three Shares 400, 600, 200, becauſe their Sum ought to be equal to the principal Sum 1200.

An Example of the Compound Rule of Fellowſhip.

Three Merchants made a Joint-Stock for their Traffick; the firſt put in 100 *l.* for two Months, the ſecond 150 *l.* for 3 Months; and the third 110 *l.* for 6 Months; and they gave the Sum of all this Money to a Man who made ſuch Advantage of it, that he gain'd 655 *l.* which they wou'd divide among them in proportion to their Money, and their time. To do this, multiply each Sum by its time, and you'll have theſe Sums 200, 450, 660, multiply each by the principal Sum 655, and divide each Product

100	150
2	3
200	450
655	655
1000	2250
1000	2250
1200	2700
131000	294750
1310 (100	1310 (22
00000	3275
	1310
	6550
	1310
	6550
	1310
	0000

110
6
——
660
655
——
3300
3300
3960
——
432300
1310 (330
——
3910
1310
——
0000

by the Sum 1310 of all those Sums, you will have as before, and as you see here, each Merchant's Share, namely 100 *l.* for the first, 225 *l.* for the second, and 330 *l.* for the third.

We shall omit several other Rules in Arithmetick, which are usually found in Books, because they scarce belong to the Mathematicks, or if they do, they are rather curious than useful, and besides they may be easily resolved by Algebra, *if one is never so little acquainted with it, as the Rule of Aligation, and the Rule of false Position, which we shall again add here, without any Demonstration, as being too prolix from* Euclid's *Elements, tho' most easily discovered from the Principle of* Algebra.

PROBLEM VI.

To resolve a Question by the Rule of Aligation.

THE Rule of Aligation is so call'd, because it teaches the manner of aligating and mixing together several things of different value, and shews how to find the common value of this Mixture, or the quantity which ought to be taken of each thing, that they may be reduc'd to a certain Number and Price. We shall give an example in both cases, the first whereof is call'd *Rule of Aligation by Equality*, and the second *Rule of Aligation by Inequality.*

Ex-

Example in the Rule of Aligation by Equality.

A Citizen had two ſorts of Grains, which he wou'd mix together, ſo that in the mixture there ſhou'd be as many Meaſures of one ſort of Grains as of the other: for example, 6 Meaſures of Wheat at 30 *s.* the Meaſure, and 6 Meaſures of Rye at 20 *s.* the Meaſure; and he would know at how much he may ſell this Mixture by the Meaſure, ſo as neither to loſe nor gain.

To do this, add together the Price, 30 and 20, of the two ſorts of Grains, and divide their Sum 50 by the number of the different ſorts of Grains, which is here two, and you will have 25 *s.* for the value of a Meaſure of theſe two ſorts of Grains mix'd together.

Example in the Rule of Aligation by Inequality.

A Goldſmith would make a Dozen of Silver Cups, which might weigh together no more than 8 Marcs, at the Price of 24 Livres the Marc, with 4 Ingots of Silver of different prices, the one at a higher price, and the other at a lower price; for example at 18, 21, 26, and 29 Livres the Marc.

To find how much he ought to take of each Ingot, to be ſo mix'd together as the Mixture may be worth 24 Livres the Marc, which we ſhall call *Mean Price,* compare the four different prices 18, 21, 26, 29, from two to two, ſo that one ſhou'd be greater and the other leſs than the mean price 24, as 18, 26, and 21, 29; and write oppoſite to the greateſt

18—2	If 16. 2. 8 —— 1	——	18 *Livres.*
26—6	16. 6. 8 —— 3	——	78 *Livres.*
21—5	16. 5. 8 —— $2\frac{1}{2}$	——	$52\frac{1}{2}$ *Livres.*
29—3	16. 3. 8 —— $1\frac{1}{2}$	——	$43\frac{1}{2}$ *Livres.*
16	8		192 *Livres.*

26, the exceſs of the mean 24 above the leaſt 18; and reciprocally oppoſite to the leaſt 18, the exceſs 2 of the greateſt 26 above the mean 24. Write in like manner oppoſite to the greateſt 29, the exceſs 3 of the mean 24 above the leaſt 21; and reciprocally oppoſite to the leaſt 21, the exceſs 5 of the greateſt 29 above the mean 24. Thus you will have theſe four exceſſes 2, 6, 5, 3, the Sum of which 16 ſhews that if you wou'd have the weight of the 12 Cups to be 16 Marcs, in which caſe 16 Marcs wou'd be worth 184 Livres, at the rate of 24 Livres the Marc, you muſt take 2 Marcs at 18 Livres the Marc, which makes 36 Livres; 5 Marcs, at 21 Livres the Marc, which makes

makes 105 Livres; 6 Marcs at 26 Livres the Marc, which makes 156 Livres; and 3 Marcs at 29 Livres the Marc, which makes 87 Livres; for thus the whole mixture wou'd also be worth 184 Livres. But since it is desir'd that the 12 Cups, shou'd weigh only 8 Marcs, you must diminish in proportion, as here one half, by as many direct Rules of Three, as there are different Prices, by saying if 16 give 2, how much will 8 give, and so of the rest, as you see in the preceding Table, where 'tis visible that to make of these four different sorts of Ingots, a mixture of 8 Marcs, at the rate of 24 Livres the Marc, which makes 192 Livres; you must take 1 Marc, at 18 Livres the Marc, which makes 18 Livres; 3 Marcs, at 26 Livres the Marc, which makes 78 Livres; 2 $\frac{1}{2}$ Marcs, at 21 Livres the Marc, which makes 52 $\frac{1}{2}$ Livres; and 1 $\frac{1}{2}$ Marc at 29 Livres the Marc, which makes 43 $\frac{1}{2}$ Livres, and that makes in all likewise 192 Livres for the Proof.

SCHOLIUM.

This is the Method which is commonly found among Authors, which gives but one Solution, but *Algebra* can furnish us with an Infinity of other Solutions: For if instead of the given Numbers you put the Letters, a, b, c, d, m, p, and the Letters x, y, z, ω, for the four Numbers requir'd, you will find an infinite Number of Solutions, as you see in this Table, where the two Letters x, y,

$$18 = a - x = x = 2$$
$$21 = b - y = y = 2$$

$$26 = c - z = \frac{pd - pm + by - dy + ax - dx}{d - c} = \frac{2}{3}$$

$$29 = d - \omega = \frac{pm - pc + cy - by + cx - ax}{d - c} = 3\frac{1}{3}$$

$$24 = m$$
$$8 = p$$

are indetermin'd, which consequently may be taken, such as you will, provided the value of x be less than $\frac{pa - pm}{d - a}$, that is in this Example, $3\frac{7}{11}$, and the value of y less than $\frac{pd - pm + ax - dx}{a - b}$. Thus by suppposing $x = 2$, in which case, y ought to be less than 3, and $y = 2$, you will find $z = \frac{2}{3}$, and $\omega = 3\frac{1}{3}$, for the second Solution; and by supposing $x = 3$, in which case y ought to be less than $\frac{7}{8}$, and $y = \frac{7}{9}$ you

you will find $z=\frac{7}{27}$, and $\omega=3\frac{26}{27}$, for the third Solution, and ſo *ad infinitum.*

PROBLEM VII.

To reſolve a Queſtion by the Rule of falſe Poſition.

THIS Rule is ſo call'd, becauſe by making one or two falſe Suppoſitions of the Number requir'd, it teaches to find the true one. When but one Suppoſition is made, it is call'd *Single Rule of falſe Poſition*, and when you make two Poſitions, it is call'd *Compound Rule of falſe Poſition.*

Example in the Single Rule of falſe Poſition.

I wou'd divide 20 Crowns among 3 Perſons, ſo that the firſt ſhou'd have $\frac{1}{2}$, the ſecond the $\frac{1}{3}$ part, and the third the $\frac{1}{4}$ of a certain unknown Number; to find that Number, and alſo to find every one's part, you may take the propos'd Number 20, or any other at pleaſure for that requir'd, but to avoid Fractions, it is better to aſſume at a venture a Number which is diviſible by 2, by 3, and by 4, that is to ſay, which has its $\frac{1}{2}$, and its $\frac{1}{3}$, and its $\frac{1}{4}$, and the leaſt will be the moſt convenient as 12, the $\frac{1}{2}$ whereof is 6, the $\frac{1}{3}$ is 4, and the $\frac{1}{4}$ is 3, theſe taken together make 13, which is a Number leſs than the propos'd 20, and ſhews that the ſuppos'd Number 12 is falſe, and too ſmall, and that the firſt Perſon cannot have 6, nor the ſecond 4, nor the third 3, but ought to have more;

12 *Suppos'd Number.*				
6 *Half* —	*if* 13. 6. 20 —	$9\frac{3}{13}$	*by* 2	
4 *Third* —	*if* 13. 4. 20 —	$6\frac{2}{13}$	*by* 3	$18\frac{6}{13}$
3 *Fourth* —	*if* 13. 3. 20 —	$4\frac{8}{13}$	*by* 4	
13 *Sum.*	*Proof.*	20		

nevertheleſs the Numbers 6, 4, 3 are not unuſeful, for they ſhew, that to find the ſhare of each Perſon, the propos'd Number 20 ought to be divided into three Numbers proportionals to 'em, which is done by the Rule of Fellowſhip, as you ſee here, where we have found $9\frac{3}{13}$ for the part of the firſt, $6\frac{2}{13}$ for the part of the ſecond, and $4\frac{8}{13}$ for the part of the third; and the double of the firſt part, or the triple of the ſecond, or the quadruple of the third, will give the ſame Number $18\frac{6}{13}$, for that requir'd.

Exam-

Example in the Compound Rule of false Position.

A Master Bricklayer took a Labourer, for 8 Days, on condition that he shou'd have 20 pence every day he work'd, and forfeit 10 pence every Day he idled. At 8 Days end he receiv'd 100 pence, the Question is, how many Days he work'd.

First, let us suppose he work'd, for Example, 3 Days, in which case he idled 5 Days, which gives 50 pence for-

First suppos'd Number 3 *Remainder*—90
Second suppos'd Number 5 *Remainder*—30

Product 450 60
Product 90

360
60 (6 *Number of Days requir'd.*

00

feiture, this being substracted from 60 pence that he gain'd during 3 Days, he had remaining 10 pence gain, which is 90 pence less than 100 pence, that he said he had gain'd; wherefore he shou'd have work'd more than 3 Days, opposite to which you must write the remainder 90, with the Sign —, because the gain 10 is found less than 100 by 90.

Let us suppose in the second place, that he work'd, for Example, 5 Days, in which case he shall have rested 3, which gives 30 pence less, which being substracted from 100 pence, which he gain'd during 5 Days, he hath remaining 70 pence gain, which is 30 pence less than 100 pence that he said he had receiv'd; wherefore he ought yet to have work'd more than 5 Days, opposite to which you must write as before, the remainder 30, with the same Sign—, because the gain 70 is also found less than 100 by 30.

Having thus written opposite to each suppos'd Number its deficient Number, or remainder, multiply each remainder by the suppos'd Number of the other, namely 90 by 5, and 30 by 3, the two Products will be 450, 90, whose difference 360 ought to be divided by the difference 60, of the two remainders, because these two remainders are of the same affection, otherwise you must divide by their Sum, the Sum of the two Products, and the Quotient 6 will be the number of Days requir'd.

FINIS.

A
TREATISE
OF
Trigonometry.

TRIGONOMETRY according to its Etymology, signifies the mensuration of Triangles, it also teaches us to resolve by Calculation all sorts of Triangles, as well rectilineal, as spherical, for which reason it is divided into *Rectilineal Trigonometry*, and *Spherical Trigonometry*; both considering only the Angles and the Sides of a Triangle, without having regard to its Superficies; that being a Consideration which belongs rather to *Planimetry*, of which we shall treat in *Practical Geometry*.

Since in a Triangle there are three Angles and three Sides, which depend one upon the other, it is evident that any three of these Quantities being given, except the three Angles of a Rectilineal Triangle, the others may be known, by the reasonings which Trigonometry teaches us, that is two Angles and a Side; or two Sides and an Angle, or gain three Sides will determine the Triangle, but not the three Angles of a Rectilineal Triangle, for these Angles does not determine the Quantity of the Sides, but only their proportion, it being certain that one may imagine an infinity of equiangled rectilineal Triangles, such as have not their Sides respectively equal: Besides we are not at liberty to suppose the three Angles of a Rectilinael Triangle. as we please, because if we suppose two of 'em, each of a certain quantity, the third ought of necessity to be the remainder of these two to 180 degrees, *by* 32. 1. so that these three given Angles are equivalent but to two given things, and consequently they do not sufficiently determine the other parts of the Triangle. It is not the

the ſame in a ſpherical Triangle, of which the three Angles determine the three Sides, as you will find in *Spherical Trigonometry*, which ſhall be preceded by the *Rectilineal Trigonometry*, and this by the method of Conſtruction of Tables, by which we ſhall begin this Treatiſe, after having explain'd the

DEFINITIONS.

I.

Plate I. Fig. I. A *Circle* is a Plane terminated by one only Curve Line, which is call'd *Circumference*, as BCD, within which there is a point call'd *Centre*, as A, from which all right Lines drawn to the Circumference as AB, AC, AD, which are call'd *Semi-Diameters*, are equal to each other.

II.

The *Diameter of a Circle* is a right line drawn thro' the Centre of the Circle, and terminated at both ends by the Circumference of the ſame Circle as B D, which paſſes thro' the Centre A of the Circle.

III.

An *Arc of a Circle* is part of the Circumference of a Circle, as DE, DF, CF, *&c.* Such an Arc is call'd a *Semicircle*, when it is equal to half the Circumference of the Circle, BCD, or BED, and a *Quadrant*, when it is equal to half the Semi-circle, as BC, or CD, which is always 90 Degrees, becauſe the Semi-circle is 180 Degrees, and the whole Circle 360.

IV.

A *Degree* therefore is an Arc of a Circle, which is equal to the three hundred ſixtieth part of the Circumference of the Circle. Thus *Mathematicians* have been pleas'd to divide the Circumference of a Circle into 360 Degrees and they have alſo divided the Degree into 60 *Minutes*, the Minute into 60 *Seconds*, the ſecond into 60 *Thirds*, and thus *in infinitum*. This Diviſion being chiefly contriv'd to determine the value of Angles, as well *Rectilineal*, as *Spherical*.

V.

V.

A *Rectilineal Angle* is made by the Inclination of two right lines, which interſect in one point as DAF, CAF, BAF, *&c.*

VI.

A *Spherical Angle* is made by the Inclination of the Circumferences of the two great Circles of the Sphere, which interſect on the ſurface of the ſame Sphere, as ECD, DKBE. Fig. 2.

The Circumferences of two ſmall Circles may alſo interſect on the ſurface of a Sphere, and make thereon an Angle, which may alſo be made by the meeting of the Circumferences of a great Circle and a little one; but Trigonometry takes cognizance of theſe ſorts of Angles, only with reſpect to the great Circles, which are invariable, that is to ſay, all of one and the ſame magnitude, in one and the ſame Sphere.

VII.

A *Sphere* is a ſolid terminated by one only ſurface, which is call'd *Spherical Superficies*, within which there is a Point call'd *Centre*, as A, from which all right Lines drawn to the Surface as AB, AC, AD, AE, which are call'd *Semi-Diamiters*, are equal to each other.

VIII.

The *Diametre of a Sphere* is a right line, which paſſes thro' the Centre of the Sphere, and which is terminated at both ends by the ſpherical Superficies, as BD, which paſſes thro' the Centre A of the Sphere.

IX.

A *Circle of the Sphere* is that whoſe Circumference is in the Superficies of the Sphere; and when the Plane of this Circle paſſes thro' the Centre of the Sphere, in which caſe its Diameter is equal to that of the Sphere, it is call'd *Great Circle*, as BCDE; and when the Plane of this Circle paſſes not thro' the Centre of the Sphere, in which caſe its Diameter is leſs than that of the Sphere, it is call'd *Small Circle*, as FGH, whereof the Diameter FH is leſs than the Diameter BD, or CE of the Sphere.

It

It is evident that all the great Circles of the Sphere are equal to each other, and have a common Centre, which is the ſame with that of the Sphere; and that among the ſmall Circles, thoſe are only equal to each other, whoſe Planes are equally diſtant from the Centre of the Sphere.

X.

The *Poles* of a Circle of the Sphere, are two Points of the Surface of the ſame Sphere, equally diſtant each from the Circumference of the Circle. Thus the two Poles of the great Circle BKD, and alſo of the FGH, which is parallel to it, are the two Points C, E.

It is evident that the two Poles of a Circle are oppoſite, and conſequently diſtant from one another by a ſemicircle, and each diſtant from the great Circle, whereof they are the Poles, by a Quadrant, becauſe this great Circle, paſſing thro' the Centre of the Sphere, divides it in two equal parts.

XI.

The *Meaſure of an Angle* is the Number of Degrees of the Arc of any Circle, terminated by the two Lines which form the Angle, and deſcrib'd from the Angular Point. Nevertheleſs the Arc of a great Circle of the Sphere is commonly taken for the meaſure of a Spherical Angle, becauſe as we have already ſaid, Trigonometry only conſiders the great Circles of the Sphere. Thus the meaſure of the ſpherical Angle KCD is the Arc DK.

When the Arc of a Circle, which ſerves for a meaſure to an Angle, whether Rectilineal, or Spherical, is a quarter of a Circle, or 90 Degrees, this Angle is call'd *Right Angle*; and it is call'd *Acute Angle*, when its meaſure is an Arc leſs than 90 Degrees; and *Obtuſe Angle* when its meaſure is an Arc greater than 90 Degrees. Laſtly thoſe are call'd Angles of the ſame kind, which are all Right, Acute, or Obtuſe; and Angles of different kind, when they are not all Right, nor all Acute nor Obtuſe.

We ſhall likewiſe call by the Name of *Right Side*, the Side of a ſpherical Triangle, which ſhall be equal to a Quadrant; *Acute Side*, that which ſhall be leſs than a Quadrant; and *Obtuſe Side* that which ſhall be greater than a Quadrant.

XII.

Fig. 1. A *Rectilineal Triangle* is that which is form'd on a Plane by the interſection of three right Lines, as AGF, which

which is call'd *Right angl'd* when there is a Right Angle; and *Oblique angled* when it has no right Angle. These two terms agree also with a spherical Triangle.

XIII.

A *Spherical Triangle* is what is form'd upon the surface of a Sphere by the intersection of three great Circles of the same Sphere, as CKD, which is call'd *Bi-right-angled*, when it has two right Angles; and *Tri-right-angled*, when its three Angles are right ones. But a spherical Triangle is call'd *Quadrantal Triangle*, where any one of the Sides or of the Angles is 90 Degrees; and it is call'd a *Non-quadrantal Triangle*, where there is neither Angle nor Side of 90 Degrees. In every Rectangular Triangle the Side opposite to the right Angle is call'd *Hypotenuse*. Fig. 2.

XIV.

The *Chord* or *Subtense* of an Arc of a Circle, is a right Line drawn thro' the two extremities of that Arc. Thus the Chord of the Arc DLE, is the right Line DE, and the Chord of the Arc BME is the right Line BE. Fig. 1.

It is evident that a Chord belongs to two Arcs of the Circle, which taken together are equal to the whole circumference of the Circle. Thus the Chord BE is common to the two Arcs BME, BCDE, which together compleats the whole circumference of a Circle.

It is also evident that the Chord of an Arc equal to a semi-circle is equal to its Diameter; as for example, the Chord of the semi-circle BCD is the Diameter BD. When we speak of the Chord of an Arc, it is commonly suppos'd that this Arc is greater or less than a semi-circle.

XV.

The *Complement Chord* of an Arc is the Chord of the remainder of this Arc, from a semi-circle, or 180 Degrees. Thus the Complement Chord of the Arc DLE is the right Line BE.

XVI.

The *Right Sine* of an Arc, or of an Angle, is a right Line drawn from one of the two extremities of that Arc, perpendicularly to the Diameter which passes thro' the other extremity. Thus the right Sine of the Arc DF, or of its

Plate I. Fig. I.

Angle DAF, is the right Line FG, and the right Sine of the Arc CF, is the right Line FN.

Since the right Line drawn from the Centre at right Angles, upon the Chord of an Arc, divides this Chord into two equal parts, *per* 3. 3. and also the Arc into two equal parts; it may be also said that the right Sine of an Arc is the half of the Chord of the double Arc. Thus the right Sine of the Arc DF, is the right Line FG, which is equal to the half of the Chord EF, of the double Arc EDF. From whence it follows that when the Chord of an Arc is known in Numbers, the right Sine of half this Arc is also known in Numbers, since it is half the Chord; and reciprocally, when the right Sine of an Arc is known, the Chord of the double Arc is likewise known, namely by doubling the right Sine.

XVII.

The *Versed Sine* of an Arc, or of an Angle, is the part of the Diameter compriz'd between the extremity of the Arc and its right Side. Thus the versed Sine of the Arc DF, or of the Angle DAF, is the part DG of the Diameter BD; and the versed Sine of the Arc BCF, or of the Angle BAF, is the part BG of the Diameter BD; where 'tis plain that the Sum of the versed Sines of the two Arcs, which taken together make a semicircle, is equal to the Diameter. When we simply speak of a *Sine*, it is commonly understood of a right Sine.

Since the right Sine of an Arc is perpendicular to the versed Sine of the same Arc, it may be also said that the versed Sine of an Arc is a right Line drawn from the extremity of this Arc perpendicularly to the right Sine of the same Arc, which is drawn thro' the other extremity thereof.

XVIII.

The *Tangent* of an Arc, or of an Angle, is a right Line drawn from one of the two extremities of this Arc perpendicularly to the Diameter of this Arc, and terminated by the meeting of another right Line drawn from the Centre thro' the other extremity of the same Arc. Thus the Tangent of the Arc DF, or of the Angle DAF, is the right Line DI, and the Tangent of the Arc CF, or of the Angle CAF is the right Line CH.

It is evident that the Tangent of the Quadrant BC, or CD is infinite, because the Tangent which shou'd be drawn thro' the point B, or thro' the point D, can never be cut by the Line AC, which is parallel to it.

The

XIX.

The *Secant* of an Arc, or of an Angle, is that right Line, which being drawn from the Centre thro' the other extremity of the Arc, terminates its Tangent. Thus the Secant of the Arc DF, or of the Angle DAF, is the right Line AI; and the Secant of the Arc CF, or of the Angle CAF, is the right Line AH. Plate I. Fig. 1.

It is evident that the Secant of the Quadrant BC, or CD, is infinite, because the Line AC being parallel to the Tangent BK, or BI, cannot, being produc'd, meet it in any point.

It is alſo evident that every right Sine, every Tangent, and every Secant belongs to two Arcs, which taken together always makes 180 Degrees, or a ſemi-circle. This is already manifeſt with reſpect of the Sine FG, which belongs as well to the Arc BCF, as to the Arc DF. It is the ſame with the Tangent DI, and the Secant AI of the Arc DF, which belongs alſo to the Arc BCF, becauſe its Tangent BK is equal to the Tangent DI, and the Secant AK to the Secant AI, by reaſon of the equality which is between the two Rectangular Triangles ADI, ABK *per* 26. 1.

XX.

The *Complement* of an Arc, or of an Angle, is that by which is it leſs or greater than 90 Degrees or $\frac{1}{4}$ of the Circle. Thus the Complement of the Arcs BF, DF, is the Arc CF, by which the greateſt Arc BF ſurpaſſes the Quadrant BC, or the leaſt DF is leſs than the Quadrant CD. Where 'tis plain that two Arcs or two Angles, which taken together make 180 Degrees, have one and the ſame Complement. Thus in each of theſe two Arcs DF, BF, the *Sine Complement* is the right Line FN, the *Tangent Complement* is the right Line CH, and the *Secant Complement* is the Line AH. And the Sine Complement FN, or AG, being added to the *Radius* AB, gives the verſed Sine BG, of the Arc BF, greater than the Quadrant BC, and that being ſubſtracted from the Radius AD, gives the verſed Sine DG of the Arc DF, leſs than the Quadrant CD.

XXI.

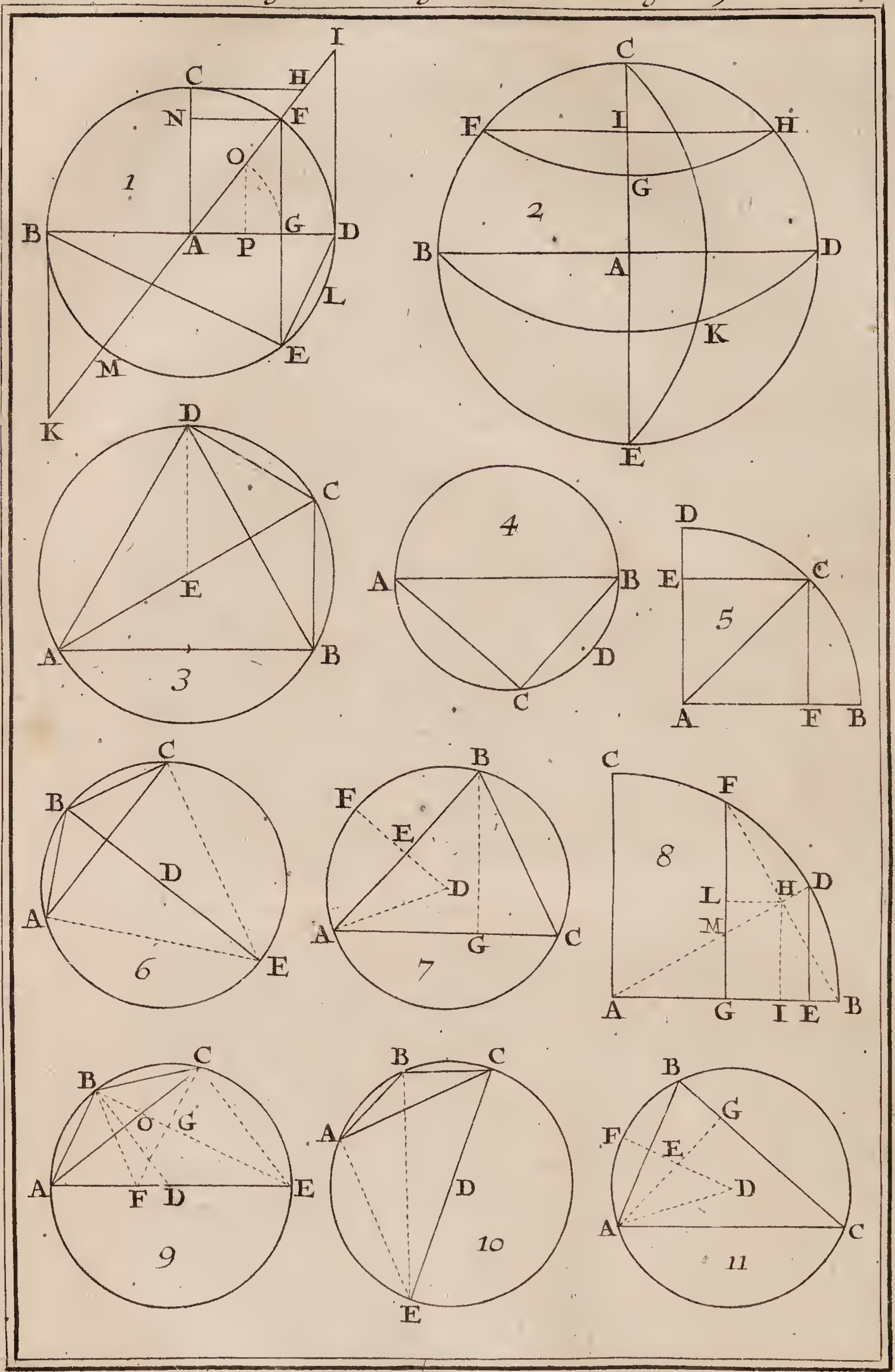
The *Radius* or *Whole Sine* is the Sine of the Quadrant, or of 90 Degrees, which is always equal to the ſemi-diameter of the Circle, and 'tis for this Reaſon call'd *Radius*,

and likewise *Sine*, because it is the greatest of all the Sines which can be drawn in one and the same Circle. Thus the whole Sine, or Radius is the right Sine AC of the Quadrant BC, or CD, which Sine falling in the Centre A of the Circle, is equal to its semi-diameter as you see.

Plate 1. Fig. 1. 'Tis upon the Quantity of the Radius depends that of the Sines, of the Tangents, and of the Secants of all the Arcs, of the Quadrant, for it is evident that of the Angle DAF the Sine FG, the Tangent DI, and the Secant AI, are not here of the Quantity which you see, any otherwise than with respect to that of the Radius, or semi-diameter AD: So that if this Radius encreases or diminishes, the Sine, the Tangent and the Secant of the same Angle DAF will encrease or diminish in proportion, and that which was, for Example, the Sine, may become the Tangent, and reciprocally that which was the Tangent may become the Sine by changing the Radius, yet without changing the proportion. Thus the right Line FG, which is the Sine of the Angle DAF, with respect of the Radius AD, will become the Tangent of the same Angle DAF, with respect of the Radius AG, because if from the point A of the Angle DAF, you describe thro' the point G, the Arc of a Circle GO; which will be the measure of the Angle DAF *per Def.* 11. and thro' the extremity G of this Arc GO, the perpendicular FG, being drawn, will be its Tangent, with respect to which AF will be its Secant, and its Sine will be the right Line OP perpendicular to the Radius AG.

Thus the Sine, the Tangent and the Secant of any Arc, or of any Angle whatsoever, have to the Radius an unalterable Ratio, it being certain *per* 4. 6. that there is the same Ratio, for example, of the Sine OP to its Radius AO, as of the Sine FG, to its Radius AF, by reason of the similitude of the two rectangular Triangles AOP, AFG, and the same thing will be shewn as to the Tangent and Secant. Wherefore if we once know in Numbers the value of these Lines to a Radius of a certain bigness we may easily know it by the Rule of Three to a Radius of any other given bigness; so that all the difficulty consists in determining the magnitude of all these Lines to a given Radius, which we shall teach methodically in the first Book.

BOOK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BOOK I.

Of the Conſtruction of Tables.

THE *Geometricians* who firſt diſcover'd the uſefulnes of Sines, did divide the Radius into 60 equal parts, and each part into 60 other equal leſs parts, which they call'd *Minutes* and made a Table call'd *Canon*, or *Table of Sines*, which ſhew'd the Number of ſuch parts as are contain'd in the Sines of all the Degrees of the Quadrant. But as this Number 60, or rather 3600 parts only is neither convenient for the Practice, nor great enough to give the Sine, without a ſenſible error, by reaſon of the Fractions which are omitted, and of the irrational Numbers which commonly occur in this computation; the Moderns have ſuppos'd the Radius of many more parts, to the end that the error which neceſſarily ariſes from neglected Fractions, and from the irrational Numbers which cannot be avoided, might not be ſo conſiderable in a greater Number of parts; and the Radius is commonly ſuppos'd to conſiſt of 100000 parts, or of 10000000, and on this ſuppoſition they have computed the bigneſs not only of the Sines, but likewiſe the Tangents and Secants of the Degrees and Minutes of the Quadrant, of which they made Tables commonly call'd the *Tables of Sines, of Tangents, and of Secants*, or ſimply *the Tables of Sines*, the Conſtruction whereof we ſhall teach, and afterwards their uſe in the following Chapters, and firſt we ſhall ſhew the Computation of that of the Sines; ſecondly that of the Tangents, thirdly, that of the Secants, fourthly that of Logarithms, and laſtly we'll teach the uſe of all theſe Tables.

CHAP. I.

Of the Computation of SINES.

THE Computation of Sines is easy by the Computation of Chords which are double the Sines of half the Arcs they subtend, wherefore we shall hereafter work indifferently by the Sines and Chords, according as we shall find it convenient.

PROPOSITION I.

THEOREM

The two Rectangles under the two opposite Sides of a Quadrilateral Figure inscrib'd in a Circle, are together equal to the Rectangle under the two Diagonals.

Plate 1. Fig. 3. I Say that the Rectangle under the two Diagonals AC, BD, of the Quadrilateral Figure ABCD, inscrib'd in a Circle, is equal to the Sum of the Rectangle under the two opposite Sides AB, CD, and of the Rectangle under the two other opposite Sides AD, BC.

DEMONSTRATION.

If you make the Angle ADE, equal to the Angle CDB, then *by* 32. 1. by reason of the Angle DAC, equal to the Angle DBC, *by* 21. 3. the two Triangles AED, BCD, are equiangled, and by 4.6, the Ratio of the two Sides AD, AE, is equal to that of the two BD, BC, and *by* 16. 6. the Rectangle under AD, BC, is equal to the Rectangle under AE, BD. Also *by* 32. 1. the Triangle CDE is equiangular to the Triangle ABD, by reason of the Angle DCE equal to the Angle ABD, *by* 21. 3. and of the Angle CDE equal to the Angle ADB, as will appear by adding to each of the two equal Angles ADE, BCD, the Angle EDB. Wherefore *by* 4. 6. the four Lines AB, BD, CE, CD, will be proportional; and *by* 16. 6. the Rectangle of the Lines AB, CD, will be equal to the Rectangle of the Lines BD, CE, and because the Rectangle under AE, BD, with the Rectangle under BD, CE, is equal to the single Rectangle under BD, AC, *by* 1. 2. it follows that the

Rectangle under AB, CD, with the Rectangle under AD, BC, is also equal to the Rectangle under AC, BD. *Which was to be demonstrated.*

PROPOSITION II.

PROBLEM.

The Chord of an Arc being given, to find the Chord of the Complement of that Arc.

INstead of supposing the Radius of 10000000 Parts, we will allow it 10000000.00, by adding to it towards the right hand two Cyphers more, so that the error which arises in the Calculation by neglecting the Fractions, when there are any, or by the irrational Numbers which may happen in this Problem, may remain in the two last Figures, and likewise that these two Figures being cut off at the end of the Calculation, you may have as exactly as possible the value of the Line requir'd, to a Radius of 10000000 Parts, remembring to add an Unit to this value, when the two Figures cut off at the right hand exceed 50, to compensate in some manner for what was cut off, and so to have a value nigher the true one. Plate 1.

Let us suppose then that the Arc BC is, for example, 60 degrees, in which case its Chord BC will be equal to the Radius *by* 15. 4. and consequently will be 10000000.00, the Diameter AB being 20000000.00. To find the Chord of the Complement AC, which in this supposition belongs to an Arc of 120 degrees, and which *by* 31. 3. is perpendicular to the Chord BC; substract from the Square AB, which is 400000000000000.0000, the Square BC which is 100000000000000.0000, and there will remain 300000000000000.0000 for the Square AC, *by* 47. 1. wherefore the Square Root of this Remainder will be 17320508.07, or only 17320508, for the Chord AC of 120 degrees. Fig. 4.

COROLLARY.

By this Proposition the Sine Complement of an arc is found, the right Sine thereof being known; for if this right Sine be doubled, you will have the Chord of a double Arc, the Chord of the Complement whereof may be found, the half of which will be the Sine Complement requir'd. Thus to find the Sine Complement of 30 degrees, that is to say, the

Plate 1. Fig. 4. Sine of 60 degrees, you must double the Sine of 30 degrees, which is equal to the half of the Radius, as is easy to be demonstrated, and which consequently is 5000000.00, and you will have 10000000.00, for the Chord of 60 degrees, the Chord of whose Complement was found to be 17320508, which belongs to an Arc of 120 degrees; wherefore the Arc of this Chord, namely 8660254 will be the Sine Complement requir'd, or the Sine of 60 degrees. See *Prop.* 14.

Fig. 5. But the Sine Complement CE may be more easily found by means of the given right Sine CF, of the Arc BC, of the Quadrant BCD, whose Centre is A, by drawing the Radius AC, and by substracting from its Square 100000000000000.0000, the square 25000000000000.0000 of the Sine CF, which is 5000000.00 supposing the Arc BC to be 30 degrees, in which case its Complement CD will be 60 deg. and the Remainder 75000000000000.0000 will be *by* 47. 1. the Square AF; wherefore the Square Root of this Remainder will give 8660254.03, or only 8660254 for the Line AF, or for the Sine Complement CE, that is to say, for the Sine of 60 degrees requir'd.

PROPOSITION III.

PROBLEM.

The Chord of an Arc being given, to find the Chord of double that Arc.

Fig. 6. TO find the Chord AC, of an Arc double to the Arc AB, whose Chord is given; draw thro' the Centre D the Diameter BE, and join the Chords AE, CE, BC, the two first of which, AE, CE, are known and are equal to each other, because they are the Chords of the Complements of the Arcs AB, BC, the Chords whereof are also suppos'd known and equal to each other: Wherefore the two Rectangles under AB, CE, and under AE, BC, will be also known and equal to each other, the Sum whereof will consequently be double to each; and as it is equal to the Rectangle under the Diagonal AC, BE, *by Prop.* 1. it follows that if you divide it by the Diameter BE, or its half, that is to say, the Rectangle AB, CE by the Radius, you will have the Chord AC of the double Arc requir'd.

CO-

COROLLARY.

From this fundamental Method the following Analogy is is drawn, in order to find the Chord of the double Arc, by the means of the Chord of the single Arc, and of the Chord of its Complement. Plate 1. Fig. 6.

As the Radius
To a given Chord:
So is the Chord of the Complement,
To the Chord of the double Arc.

If in this Analogy you take the halves of the Consequents, and change the Chord of the Complement to double the Sine Complement, which is the same thing, you will have this other Analogy, which serves to find the Sine of the double Arc, when the Sine of the single Arc and its Sine Complement are given.

As the Radius
To the given Sine:
So is double the Sine Complement
To the Sine of the double Arc.

This Analogy may be discover'd directly by the Sines, and independantly from the Chords, thus:

If the Sine DE of the Arc BD be given, which I suppose less than the half of the Quadrant BC, in which case its double BDF will be also less than the Quadrant BC; and you would find the Sine FG of the double Arc BF; draw the Chord BHF, and the Radius AD, which will cut the Chord BF at right angles, and in two equal parts, at the Point H. Draw again from the Point H, the Line HI, perpendicular to the Radius AB, and the right Line HL parallel to the same Radius AB. Fig. 8.

This Preparation being made, 'tis plain that the Line AH is the Sine Complement of the Arc BD, whose Sine is BH, or FH, or DE, and that the Perpendicular HI or LG its equal, is half the Sine FG, as the Sine BH is half the Chord BF; and that lastly the rectangular Triangles ADE, AHI, are equiangular: from whence is drawn *by* 4. 6. this Analogy:

As the Radius AD,
To the given Sine DE:
So is the Sine Complement AH,
To the half HI of the Sine FG.

which will become the same as the preceding, if you change its two last Terms into their doubles, &c

PROPOSITION IV.

PROBLEM.

The Chords of two Arcs being given, to find the Chord of the Sum of those Arcs.

Plate 1. Fig. 6. TO find the Chord AC of the Sum of the two arcs AB, BC whose Chords are given proceed by a Reasoning like that of the foregoing Proposition, and you will find that *each Chord of an Arc must be multiplied by the Chord of the Complement of the other, and the Sum of the two Products divided by the Diameter, or by double the Radius.*

COROLLARY.

From whence it follows, by taking the halves of the Chords, which are the Sines of half the Arcs, to find the Sine of the Sum of the two Arcs, whose Sines and Sine Complements are given, *each given Sine of an Arc ought to be multiply'd by the Sine Complement of the other, and the Sum of the two Products divided by the Radius.*

SCHOLIUM.

Fig. 7. There is another way independant on the preceding Propositions, to find the Chord AC of the Sum of the two Arcs AB, BC, whose Chords are given. Thus,

Draw from the Angle B the right line BG, perpendicular to the Chord AC requir'd, and divide the Arc AB into two equal parts at the Point F by the Radius DF, which will also divide into two equal parts and at right angles the Chord AB in the point E. Lastly draw again from the Centre D, thro' the point A, the Radius DA.

This Preparation being made, it is plain that the angle C is equal to the angle D, because the first is the half of the arc AB on which it stands, *by* 20. 3. and the second is also the half of the arc AB, *by constr.* From whence it follows *by* 32. 1. that the right-angled Triangle ADE is equiangled to the right-angled Triangle BGC, and *by* 4. 6. that the four lines AD, AE, BC, BG, are proportionals, the three first whereof being known, the fourth BG will be also known, the Square whereof being substracted separately from the Square AB, and from the Square BC, there will remain, *by* 47. 1. the Square AG, and the Square CG: Wherefore by extracting the Square Roots of these Remainders,

ders, the Segments AG, CG, will be known, and consequently their Sum, or the Chord AC requir'd.

Or else, to find the Sine FG of the Sum BF, of the two Arcs BD, DF, the Sines whereof DE, FH, are given, as well as their Sine Complements AE, AH, draw from the point H the line HI, parallel to the Sine DE, and the line HL parallel to the Radius AB; and in the similar right-angled Triangles ADE, AHI, it is plain that the four lines AD, DE, AH, HI are proportionals, the three first whereof being known, the fourth HI, or GL its equal, will be also known. In like manner 'tis evident that in the two similar right-angled Triangles ADE, FLH, the four lines AD, DE, FH, FL, are also proportionals, the three first whereof being known, the fourth FL will be also known; which being added to the Line GL, which was just now given, you will have the Sine FG requir'd. Plate I. Fig. 8.

PROPOSITION V.

PROBLEM.

The Chord of an Arc being given, to find the Chord of half that Arc.

TO find the Chord AB or BC, of half the Arc ABC, whose Chord AC is given; you must draw the Diameter BE, and the two Chords of the Complement AE, CE, which will be equal to each other, by reason of the two equals AB, BC, which will be found thus: Plate I. Fig. 6.

If you put $2r$ for the Diameter BE, $2a$ for the given Chord AC, and x for the two AB, BC, requir'd; you will have $\sqrt{4rr-xx}$ for one of the two Chords of the Complement AE, CE, *by Prop.* 2. and because *by Prop.* I. the Rectangle under AE, BC, with the Rectangle under AB CE, that is to say, the double of one of these two equal Rectangles, is equal to the Rectangles under the Diagonals AC, BE, you will have this Æquation, $\sqrt{16rrxx-4x^4}=4ar$, or $16rrxx-4x^4=16aarr$, or $x^4-4rrxx=-4aarr$, where you will find $xx=2rr-\sqrt{4r^4-4aarr}$, and consequently $x=\sqrt{rr+ar}-\sqrt{rr-ar}$, for the Chord AB. From whence this methodical Canon is drawn to find this Chord: *Multiply the Sum and the Difference of the Radius, and half the given Chord, each by the Radius, and the Difference of the Square Roots of each Product will be the Chord of half the given Arc.*

Or

Plate 1. Or by reason of $xx = 2rr - \sqrt{4r^4 - 4aarr}$, you will have this other more simple Canon: *Multiply the Excess of the Diameter above the Chord of the Complement of the given Arc, by the Radius, and the Square Root of the Product will be the Chord of half the given Arc.* As this Canon is very simple, and very convenient for Practice, it well deserves to have its

DEMONSTRATION.

Fig. 9. Having drawn the Diameter AE, and the Chords BE, CE, with the Radius DB, which will cut the given Chord AC at right angles, and into two equal parts, at the point O, make EF equal to EC, and join the right lines FB, FC, the last whereof FC will be cut at right angles, and in two equal parts at the point G so that the two right-angled Triangles BGF, BGC will be equal, and consequently the three lines BC, BF, BA, will be equal; wherefore the Triangle ABF is Isosceles, and consequently equiangled with the Isosceles Triangle ADB, because of the common Angle A. from whence it follows *by* 4. 6, that the Chord AB is a mean proportional between the Radius AD, and the Excess AF of the Diameter AE, above the Line EF, or above the Chord of the Complement EC, which being known, the excess AF will be also known, which being multiply'd by the Radius AD, the Square Root of the Product will be the Chord AB requir'd. *Which was to be demonstrated.*

COROLLARY.

From this Canon is drawn this other Canon, to find the Sine of half an Arc, the Sine and Sine Complement of the whole Arc being known: *Multiply the Excess of the Radius above the Sine Complement, by half the Radius, and the Square Root of the Product will be the Sine of half the given Arc.* This Canon does not differ from the preceding, except that here we work by the halves of the given quantities. See *Prop.* 16.

Fig. 8. But this Sine may be found otherwise, and more easily thus: Supposing that we know the Sine FG of the Arc BDF, and the Sine Complement AG, we shall find the Sine DE, or BH, or FH of its half BD, or DF, by substracting the Sine Complement AG from the Radius AB, for the versed Sine BG, whose Square being added to the Square of the given Sine FG, you will have *by* 47. 1. the Square of the Chord BF, wherefore by extracting the Square Root of this Remainder, you will have the Chord BF, whose half will be the Sine requir'd.

SCHO-

SCHOLIUM.

By changing the first construction ever so little, discovers a Canon different from the preceding, to find the Chord AB, or BC, of half the Arc ABC, whose Chord AC, and *by Prop.* 2. the Chord of the Complement is given: namely by drawing from the extremity C, thro' the centre D, the diameter CE, and by joining the chord BE, which will be the chord of the complement of the arc AB or BC; and the chord AE, which will be the chord of the complement of the given arc ABC, which consequently will be known. Plate 1. Fig. 10.

This Preparation being made, if you put $2r$ for the diameter CE, or for the double of the Radius, a for the given chord AC, b for the chord of its complement AE, which is also given, and x for the chord AB or BC requir'd; you will have $\sqrt{4rr - xx}$, for the chord of its complement BE: and because *by Prop.* 1. the rectangle under AB, CE, with the rectangle under AE, BC, is equal to the rectangle under the diagonals AC, BE, you will have this Æquation, $2rx + bx = \sqrt{4aarr - aaxx}$, where taking the Square of each member, you will have this Æquation, $4rrxx + 4brxx + bbxx = 4aarr - aaxx$, or $4rrxx + 4brxx + bbxx + aaxx = 4aarr$; and if instead of the two Squares aa, bb, you put the single Square $4xx$, which is their equal *by* 47. 1. by reason of the right angle BCE, *by* 31. 3. you will have this other Æquation, $8rrxx + 4brxx = 4aarr$, or $xx = \frac{aar}{2r+b}$, from whence this Analogy is drawn; $2r + b : r :: aa : xx$. That is,

As the Sum of the Diameter, and of the given Chord of the Complement,
To the Radius:
So is the Square of the given Chord,
To the Square of the Chord of half the given Arc.

which shews that to find the chord AB, *you must multiply the Square of the given Chord AC, by the Radius, and divide the Product by the Sum of the Chord of the Complement, and of double the Radius, and take the Square Root of the Quotient.*

PRO-

PROPOSITION VI.

PROBLEM.

The Chords of two unequal Arcs being given, to find the Chord of their Difference.

Plate I. Fig. 10. TO find the chord AB of the difference of the two arcs AC, BC, whose chords are given; draw from the angle C of these two given chords, thro' the centre D, the diameter CE, and join the chords of the complement AE, BE, which will be also given *by Prop.* 1.

This Preparation being made, you must consider that since *by Prop.* 1. the rectangle under AB, CE, with the rectangle under AE, BC, is equal to the rectangle under the diagonals AC, BE, which is given, if from this given rectangle you substract the rectangle under AE, BC, which is also given, there will remain the rectangle under AB, CE, wherefore if you divide this remainder by the diameter CE, or by the double of the Radius, you will have the Chord AB requir'd. From whence this general Canon is drawn; *Substract from the Product under the Chord of the greatest of the two given Arcs, and the Chord of the Complement of the least, the Product under the Chord of the least, and the Chord of the Complement of the greatest, and divide the Remainder by the double of the Radius, you'll have the Chord of the Difference of the two given Arcs.*

COROLLARY.

From whence it follows that to find the Sine of the difference of two unequal Arcs whose Sines are given, and consequently their Sine-complements; *You ought to substract from the Product under the Sine of the greatest of the two propos'd Arcs, and the Sine Complement of the least; the Product under the Sine of the least, and the Sine Complement of the greatest, and divide the Remainder by the Radius.*

Fig. 8. But this Sine may be known independantly on Chords thus: To find the Sine FH of the difference DF of the two arcs BF, BD, whose Sines FG, DE, and their Sine-complements AG, AE are known; draw from the point H, the lines HI, HL, parallel to the lines DE, AB, and in the similar Triangles ADE, AMG, it will appear that the four lines AE, DE, AG, MG, are proportionals, the three first whereof being known, the fourth MG will be also known, which being substracted from the Sine FG, which is known, the

the remainder will be FM: and in the similar Triangles ADE, FHM, it appears that the four Lines AD, AE, FM, FH, are proportionals, the three first whereof being known, the fourth FM, which is the Sine requir'd, will be also known. Plate 1. Fig. 8.

SCHOLIUM.

Without knowing the chord of the difference of the two arcs whose chords are given, by a method like that which we taught in *Prop.* 4. to find the chord of their Sum, as follows:

To find the chord BC of the difference of the two arcs AFB, ABC, whose chords AB, AC are given; draw the Radius DA, and divide the arc AFB into two equal parts, in the point F, by the Radius DF, which will also divide the chord AB into two equal parts, and at right angles, in the point E: draw also from the angle A the right line AG, perpendicular to the requir'd chord BC. Fig. 11.

This Preparation being made, it is plain that the angle D is equal to the angle C, because the angle C is the half of the arc AB, *by* 20. 3. and the angle D is also the half of the same arc AB, *by Constr.* From whence it follows *by* 32. 1. that the two rectangled Triangles ADE, ACG, are equiangled to each other, and *by* 4. 6. that the four lines AD, AE, AC, AG, are proportionals, the three first whereof being known, the fourth AG will be also known, whose square being substracted separately from the squares AB, AC, there will remain *by* 47. 1. the squares of the segments BG, CG; wherefore by extracting the Square Roots of these remainders, you will have the segments BG, CG, whose sum will give the chord BC requir'd.

PROPOSITION VII.

PROBLEM.

The Chord of an Arc being given, to find the Chord of triple that Arc.

Having found *by Prop.* 3. the chord of the double arc, and *by Prop.* 4. the chord of the sum of the single arc, and of the double arc, you will have the chord of the triple arc requir'd. But to find this chord methodically, let us suppose that the three arcs AD, CD, BC, are equal to each other, so that the right line AB, be the chord of a triple arc, and each of the two lines Fig. 3.

AC,

Plate I. Fig. 3. AC, BD the chord of a double arc, which being equal, their rectangle will be chang'd into a ſquare, which being equal *by Prop.* 1 to the rectangle under AD, BC, which is the ſame as the ſquare of the Chord of the ſingle arc, becauſe the chords AD, BC are equal, and to the rectangle under AB, CD, it follows, that *if from the Square of the Chord of the double Arc you ſubſtract the Square of the Chord of the ſingle Arc, and divide the Remainder by the Chord of the ſingle Arc, you will have the Chord of the Triple Arc.*

COROLLARY.

From whence it follows, That to find the ſine of a triple arc, you may follow the preceding Canon by changing the chords into ſines, that is to ſay, by putting the ſines inſtead of the chords: or elſe, becauſe the difference of the two ſquares is equal to the rectangle under the Sum and the difference of their ſides, *by* 5. 2. you may follow this other Canon; *If you multiply the Sum of the Sine of the ſingle Arc, and of the Sine of the double Arc, by their Difference, and divide the Product by the Sine of the ſingle Arc, you will have the Sine of the triple Arc.*

PROPOSITION VIII.

PROBLEM.

The Chord of an Arc being given, to find the Chord of five times that Arc.

IT is evident that if *by Prop.* 3. you find the chord of a double arc, and *by Prop.* 7. the chord of a triple arc, and that laſtly *by Prop.* 4. you find the chord of the ſum of the double arc, and of the triple arc, you will have the chord of the quintuple arc, and by reaſoning as in the preceding *Problem*, you will come at this methodical Canon to find the chord of a quintuple arc, by knowing only the chords of the ſingle, double, and triple arc; *Subſtract from the Square of the Chord of the triple Arc, the Square of the double Arc, and divide the Remainder by the Chord of the ſingle Arc, and you'll have the Chord of the quintuple Arc.*

COROLLARY.

From whence it follows, that to find the Sine of a quintuple arc, you may uſe the preceding Canon, working by

by the Sines instead of the Chords, from whence there may be easily drawn this Analogy for finding the Sine of the Quintuple Arc.

As the Sine of the Single Arc
To the Sum of the Sines of the double Arc, and of the triple Arc;
So the difference of the same Sines,
To the Sine of the Quintuple Arc.

PROPOSITION IX.

PROBLEM.

The Chord of an Arc being given, to find the Chord of the third part of that Arc.

ALtho' this Problem may be resolv'd Scientifically by *Algebra*, yet we shall resolve it here Mechanically, because every one does not understand *Algebra*, and in the Practice you will have sooner done by seeking the Resolution by one or several false Positions, thus.

Since the Chord of the third part of an Arc is a little greater than the third part of the Chord of that Arc, that is to say, the Chord of an Arc is a little greater than the third of the Chord of triple that Arc, suppose for the Chord requir'd a number of parts a little greater than the third part of the given Chord, by encreasing this third by any quantity that you judge proper, to find from it the Chord of a triple Arc, equal to the given Chord. Seek then by this Chord so suppos'd, the Chord of a triple Arc, *Prop.* 7. and if this Chord is found equal to the given Chord, the suppos'd Chord will be that requir'd, otherwise you must encrease or diminish a little the suppos'd Chord, according as the Chord of the triple Arc has been found less or greater than the given Chord, and seek again by this second suppos'd Chord, the Chord of a triple Arc, and if this Chord found does not equal the given one, encrease or diminish it by continuing until you find the Chord of a triple Arc equal to the given one, after which the last suppos'd Chord will be that requir'd.

SCHOLIUM.

To avoid Trials, and to judge pretty near what ought to be put for the second supposition of the Chord requir'd, you must, after having found by the first Position of this Chord, the Chord of the triple Arc, say, by the direct

Rule of Three, if the Chord found of the triple Arc gives so much for the first suppos'd Chord, how much will the given Chord, or the true one of the triple Arc give? and you will find what ought to be suppos'd for the Chord of the third of this Arc.

Let us suppose that the Chord of 1°. 30′ is known, namely 261791.91, by means whereof you wou'd know

Given Chord of 1°. 30′.	261791.91.
Third of this Chord.	87263.97.
Added Number.	6.03.
Suppos'd Chord of 30′.	87270.00.
Chord of the Complement.	19999809.60.
Chord of 1 *Degree.*	174538.34.
Chord of 1°. 30′.	261803.36.
Found Chord of 30′.	87266.18.
True Chord of 30′.	87266.18.

the Chord of 30 Minutes. The third of this given Chord is 87263.97, to which adding at a venture this number 6.03, you will have 87270.00. for the first suppos'd Chord of 30 Minutes, the Chord of the Complement whereof was found by *Prop.* 2. to be 19999809.60, the Chord of the double Arc, or of 1 Degree by *Prop.* 3. is found to be 174538.34, and the Chord of the triple Arc, or of 1°. 30′, is found *Prop.* 7. to be 261803.36, which being different from the true Chord of 1°. 30′. which is 261791.91, shews that the suppos'd Chord of 30 Minutes, namely 87270.00, is not the true one; and to discover the true one, say if the found Chord of 1 Degree and 30 Minutes, namely 261803.36 gives 87270.00, for the suppos'd Chord of 30 Minutes, how much will the true Chord of 1 Degree and 30 Minutes, which is 261791.91 give? and you will find 87266.18, for the value which ought to be suppos'd for the Chord of 30 Minutes; and because by beginning the operation again, that is to say in seeking by this value, the Chord of a triple Arc, or of 1 Degree and 30 Minutes, you find the true Chord, that is to say the given Chord 261791.91, you may conclude that this same value 87266.18, is the true Chord of 30 Minutes, whose half 43633.09. or 43633 will consequently be the Sine of 15 Minutes.

In the same manner you may find the Chord of 10 Minutes, by means of the given Chord of 30 Minutes, which is found to be 87266.18, whose $\frac{1}{3}$ is 29088.73, to which adding at pleasure this number 1.27, you will have 29090.00 for the first suppos'd Chord of 10 Minutes, the

theChord of whoſeComplement is 19999978.84, the Chord of the double Arc, or of 20 Minutes is 58179.94, and the Chord of the triple Arc, or of 30 Minutes, is 87269.76, which being different from the true Chord of 30 Minutes, which is 87266.18, ſhews that the ſuppos'd Chord of 10 Minutes, namely 29090.00, is alſo different from the true one; and to find this true one, ſay, if the

Given Chord of 30′.	87266.18.
Third of the Chord.	29088.73.
Added Number.	1.27.
Suppos'd Chord of 10′.	29090.00.
Chord of the Complement.	19999978.84.
Chord of 20′.	58179.94.
Chord of 30′.	87269.76.
Found Chord of 10′.	29088.82.
True Chord of 10.	29088.82.

found Chord of 30 Minutes, 87269.76 gives 29090.00, for the ſuppos'd Chord of 10 Minutes, how much will the true Chord of 30 Minutes, 87266.18 give? and you will find 29088.82. for the value which ought to be given again to the Chord of 10 Minutes; and becauſe by the means of this ſecond ſuppos'd Chord, you find by an operation like the preceding, that the Chord of the triple Arc, or of 30 Minutes, is 87266.18, as is the true Chord of 30 Minutes, you are to conclude that this ſame value 29088.82, is alſo the true Chord of 10 Minutes, the half whereof 14544.41 will conſequently be the Sine of 5 Minutes. So of the reſt.

PROPOSITION X.

PROBLEM.

The Chord of an Arc being given, to find the Chord of the fifth Part of that Arc.

WE ſhall reſolve this Problem alſo mechanically, by a method like that of the preceding one, thus.

Since the Chord of a fifth part of an Arc is ſomething greater than the fifth part of the Chord of this Arc, ſuppoſe for the Chord requir'd, a number of parts ſomething greater than the fifth part of the given Chord, and by this ſuppos'd Chord ſeek by *Prob.* 8. the Chord of a quintuple Arc, and if this Chord is not equal to the given Chord, ſay by the Rule of Three, if the

found Chord of the triple Arc gives so much for the suppos'd Chord, how much will the given Chord give? and you will find what you ought to suppose for the Chord requir'd, and by this second suppos'd Chord seek again the Chord of the quintuple Arc, and if it is found equal to the given one, the second suppos'd Chord will be that requir'd, otherwise, which seldom happens, you must make a third supposition, by a second Rule of Three, *&c.*

SCHOLIUM.

Instead of working by the Chords, you may work by the Sines, as well in this Problem as in the preceding, by means whereof it will be easy to find the Sine of a Minute: For having known *by Prop.* 2. that the Sine of 30 Degrees is 5000000.00, namely half the Radius, you may know by *Prop.* 5. the Sines of 15 Degrees, of 7°. 30'. and of 3°. 45'. and *by Prop.* 9. the Sine of 1°. 15'. and the Sine of 25 Minutes; and lastly by *Prop.* 10. the Sine of 5 Minutes, and the Sine of 1 Minute; but this last Sine may be found more easily thus.

Having found the Sine of an Arc of 30 Degrees, of which the Arc of a Minute is the 1800 Part, because in 30 there are 1800 Minutes, as is known by multiplying 30 by 60; seek by *Prop* 5. the Sine of half the Arc of 30 Degrees, that is to say, the Sine of 15 Degrees, and afterwards the Sine of the half of this half, or the Sine of 7°. 30'. and continue thus to seek the Sines of the halves of the halves, until you have found the Sine of an Arc less than a Minute, which will happen here, at the eleventh Subdivision, which will give the Sine of 52'', 44''', 3'''', 45''''', which therefore is the 2048 part of the Arc of 30 Degrees; besides multiplying 52'', 44''', 3'''', 45''''', by 2048, there arises 30 Degrees, which you have also by multiplying 1 Minute by 1800, so that *by* 6. 6 there is the same Ratio of 1800 to 2048, as of 52'', 44''', 3'''', 45''''', to 1'; wherefore if instead of the two last terms you put their Sines, which are almost in the same Ratio, by reason of the smalness of their Arcs, it will appear that there is the same Ratio of 1800 to 2048, as of the Sine of 52'', 44''', 3'''', 45''''', to the Sine of 1'; and as the three first terms of this proportion are given, the fourth or Sine of 1 Minute will be also given. But to add here something new, we shall give again in the following Problem another easier method, to find the Sine of a Minute.

PRO-

PROPOSITION XI.

PROBLEM.

To find the Sine of an Arc of one Minute.

WE shall here investigate the Sine of a Minute by the means of a *Compound Arithmetical Progression*, which is a Series of Quantities, that encrease continually, according to a certain Ratio which is neither Arithmetical, nor Geometrical, but such that if you take the difference of the terms of this Progression, and the difference of these first differences, or second differences, and of these second differences, take the third differences, and so on, if there are any more to take, it will happen in the end, that the last differences are equal to each other; which can never fall out in a Geometrical Progression, where the differences always remain in Geometrical Proportion; and then you may call by the name of *simple Arithmetical Progression*, that where the first differences are equal, as it happens in the Arithmetical Progression of the natural numbers, 1, 2, 3, 4, 5, 6, &c. *Arithmetical Progression of the second Degree*, that where the second differences are equal: *Arithmetical Progression of the third degree*, that where the third differences are equal, and so on.

We have said in our *Mathematical Dictionary*, that the Sines are in this compound Arithmetical Progression; and to shew it you, we have here added the following Table, which contains in the Column F, the Sines of the

		F	G	H	I
A	0	00000.00	14544.41		
B	5	14544.41	14544.37	4	
C	10	29088.78	14544.31	6	2
D	15	43633.09	14544.23	8	2
E	20	58177 32			

Arcs which exceed each other by 5 Minutes, which may be constructed by finding first *by Prop.* 8. the Sine of 5 Minutes, which is here over against B, and *by Prop.* 3. the Sine of 10 Minutes, which is over against C, and lastly *by Prop.* 4. the Sine of 15 Minutes, which is over again

D, the Sine of 20 Minutes which is over againſt E, and ſo on. Thoſe Sines of the Column F are ſuch that if you take their Differences G, and of theſe firſt Differences G, the ſecond Differences H, and laſtly of theſe ſecond Differences H, the third Differences I, theſe laſt Differences I are equal; where you ſee that theſe ſame Sines are in an *Arithmetical Progreſſion of the third degree*, and that conſequently the Numbers of the Column G, are in an *Arithmetical Progreſſion of the ſecond Degree*, and the Numbers of the Column H in a *Simple Arithmetical Progreſſion.*

You may among all theſe Numbers in ſimple and compound Arithmetical Progreſſion, find as many other Numbers as you will in the ſame Progreſſion. Wherefore if in this Example you find between each Number of the Column F, four Numbers in the ſame Progreſſion of the third Degree, ſo that the Diviſor be 5; for 'tis as if you divided each Interval into 5 equal Parts, by 4 Numbers which ſhou'd be inſerted in each Part, you will have the Sines of each Minute.

To make this Diviſion, you muſt, as you ſee here, diſpoſe in ſuch manner the Numbers of the Column F, that they be ſufficiently diſtant from each other, that you may place between them in the intermediate ſpace, four Numbers which keep the ſame Progreſſion, by beginning to fill up the Column I, and afterwards the Column H, then the Column G, and laſtly the Column F, where the Sine of each Minute will be found: which will be eaſy, if you have once found the firſt Number of each Column: for it is evident, that having found the firſt Number of the Column I, all the reſt are found, ſince they are equal; and that knowing the firſt Number of the Column H, all the reſt will be known by the continual Addition of thoſe of the Column I, becauſe the Numbers of the Column H encreaſe; and in like manner knowing the firſt Number of the Column G, all the reſt will be known by the continual Subſtraction of thoſe of the Column H, becauſe the Numbers of the Column G decreaſe; and laſtly knowing the firſt Number of the Column F, you will know all the reſt by the continual Addition of thoſe of the Column G, becauſe the Numbers of the Column F gradually encreaſe.

To find the firſt Number of the Column I, divide the firſt given Number 2 of the ſame Column I, in the firſt Table, by the Cube 125 of the Diviſor 5, and becauſe the Diviſion cannot be made, add to this given Number 2 three Cyphers to the Right-Hand, and conceive all the reſt of the firſt Table to be encreas'd in the ſame manner; to

to have this other Number 2000 to be divided by 125, and the Quotient 16 will be the first Number requir'd, with which the whole Column I is to be fill'd.

		F	G	H	I
A	0	0000.00000	2908.88424	096	016
	1	2908.88424	2908.88328	112	016
	2	5817.76752	2908.88216	128	016
	3	8726.64968	2908.88088	144	016
	4	11635.53056	2908.87944	160	016
B	5	14544.41000	2908.87784	176	016
	6	17453.28784	2908.87608	192	016
	7	20362.16392	2908.87416	208	016
	8	23271.03808	2908.87208	224	016
	9	26179.91016	2908.86984	240	016
C	10	29088.78000	2908.86744	256	016
	11	31997.64744	2908.86488	272	016
	12	34906.51232	2908.86216	288	016
	13	37815.37448	2908.85928	304	016
	14	40724.23376	2908.85624	320	016
D	15	43633.09000	2908.85304	336	016
	16	46541.94304	2908.84968	352	016
	17	49450.79272	2908.84616	368	016
	18	52359.6[illegible]888	2908.84248	384	
	19	55268.48136	2908.83864		
E	20	58177.32000			

To find the first Number of the Column H, having multiply'd the first-found Figure 16 by 100, substract the Product 1600 from the first given Number 4 of the same Column H in the first Table, encreas'd likewise by three Cyphers, namely the Numb:r 4000, and divide the Remainder 2400 by the Square 25 of the Divisor 5, and the Quotient 96 will be the first Number of the Column H, to which adding the first-found Number 16 of the Column I, you will have 112 for the second Number of the Column

H, to which if you add likewise the same found Number 16 of the Column I, you will have 128 for the third Number of the Column H, and so on.

To find the first Number of the Column G, having multiply'd the Sum of the two first found Numbers 96, 16, of the two preceding Columns H, I, or which is the same thing, the second found Number 112 of the Column H by 10, add the Product 1120 to the first given Number 14544.41 of the same Column G, in the first Table, increas'd likewise by three Cyphers, namely to the Number 14544.41000, and divide the Sum 14544.42120, by the Divisor 5, and the Quotient 2908.88424 will be the first Number of the Column G, from which substracting the first found Number 96 of the Column H, you will have 2908.88328 for the second Number of the Column G, from which if you substract in like manner the second found Number 112 of the Column H, you will have 2908.88216 for the third Number of the Column G. So of the rest.

Since the first Number of the Column F is 0, it follows that its second Number, or the Sine of a Minute, is the same as the first Number 2908.88424 of the Column G, to which adding the second Number 2908.88328 of the same Column G, you will have 5817.76752 for the Sine of two Minutes, to which if you add likewise the third correspondent Number 2908.88216 of the Column G, you will have 8726.64968, for the Sine of three Minutes; and so you will find the Sine of all the Minutes to that of 20 Minutes, which ought to be found the same as before, as well as those of 5, of 10, and of 15, which are already known.

DEMONSTRATION.

To shew you the Original and Demonstration of this Method, make an Analytical Table like the preceding, in the following manner, and make another Analytical Table like the first of the two preceding ones, by putting in the Column F, only from 5 to 5, the Quantities of the first of the two following Tables, which are in the same Column F, namely those which answer to the Letters A, B, C, D, E; and take the Differences of all these Quantities, to make the Column G of them; and of these first Differences again the Differences, to make of 'em the Column H; and lastly, of these second Differences again the Differences, which will be equal, each whereof will be 125d, to make of them the Column I.

This

		F	G	H	I
A	0	a	b	c	d
	1	$a+b$	$b-c$	$c+d$	d
	2	$a+2b-c$	$b-2c-d$	$c+2d$	d
	3	$a+3b-3c-d$	$b-3c-3d$	$c+3d$	d
	4	$a+4b-6c-4d$	$b-4c-6d$	$c+4d$	d
B	5	$a+5b-10c-10d$	$b-5c-10d$	$c+5d$	d
	6	$a+6b-15c-20d$	$b-6c-15d$	$c+6d$	d
	7	$a+7b-21c-35d$	$b-7c-21d$	$c+7d$	d
	8	$a+8b-28c-56d$	$b-8c-28d$	$c+8d$	d
	9	$a+9b-36c-84d$	$b-9c-36d$	$c+9d$	d
C	10	$a+10b-45c-120d$	$b-10c-45d$	$c+10d$	d
	11	$a+11b-55c-165d$	$b-11c-55d$	$c+11d$	d
	12	$a+12b-66c-220d$	$b-12c-66d$	$c+12d$	d
	13	$a+13b-78c-286d$	$b-13c-78d$	$c+13d$	d
	14	$a+14b-91c-364d$	$b-14c-91d$	$c+14d$	d
D	15	$a+15b-105c-455d$	$b-15c-105d$	$c+15d$	d
	16	$a+16b-120c-560d$	$b-16c-120d$	$c+16d$	d
	17	$a+17b-136c-680d$	$b-17c-136d$	$c+17d$	d
	18	$a+18b-153c-816d$	$b-18c-153d$	$c+18d$	
	19	$a+19b-171c-969d$	$b-19c-171d$		
E	20	$a+20b-190c-1140d$			

		F	G	H	I
A	0	a	$5b-10c-10d$	$25c+100$	$125d$
B	5	$a+5b-10c-10d$	$5b-35c-110d$	$25c+225$	$125d$
C	10	$a+10b-45c-120d$	$5b-60c-335d$	$25c+350d$	
D	15	$a+15b-105c-455d$	$5b-85c-685d$		
E	20	$a+20b-190c-1140d$			

This being done, it is evident that the first Quantity $125d$ of the Column I of this last Table, represents the first Number 2 of the same Column I, of the first Table; and that thus you have this Æquation $125d = 2$, where you see, that to find the Quantity d, which is the first Quantity of the Column I of the first Analytical Table, you must divide, as we have said, 2 by 125, which is the Cube of the Divisor 5, as will be easily known by him who shall attentively consider the Order and Series of the Numbers which are found in the first Analytical Table, the first Numbers whereof on the Left-hand are in Arithmetical Proportion, the following ones towards the Right-hand are Triangular Numbers, and the following ones, by proceeding still towards the Right-hand, are Pentagonal Numbers, *&c.*

It is also evident that the first Quantity $25c + 100d$ of the Column H, represents the first Number 4 of the same Column H of the first Table, and that thus you have this Æquation, $25c + 100d = 4$; where 'tis plain, that to find the Quantity c, which is the first Number of the Column H, you must substract $100d$ from 4, and divide the Remainder $4 - 100d$ by the Square 25 of the Divisor 5, as the Rule prescribes.

It is again evident, that the first Quantity $5b - 10c - 10d$ of the Column G, represents the first Number 14544.41 of the same Column G of the first Table, and that thus you ought to make this Equation, $5b - 10c - 10d = 14544.41$, where you see that to find the Quantity b, which is the first Number of the Column G, you must add $10c + 10d$, to 14544.41, and divide the Sum $10c + 10d + 14544.41$ by the Divisor 5, as was done.

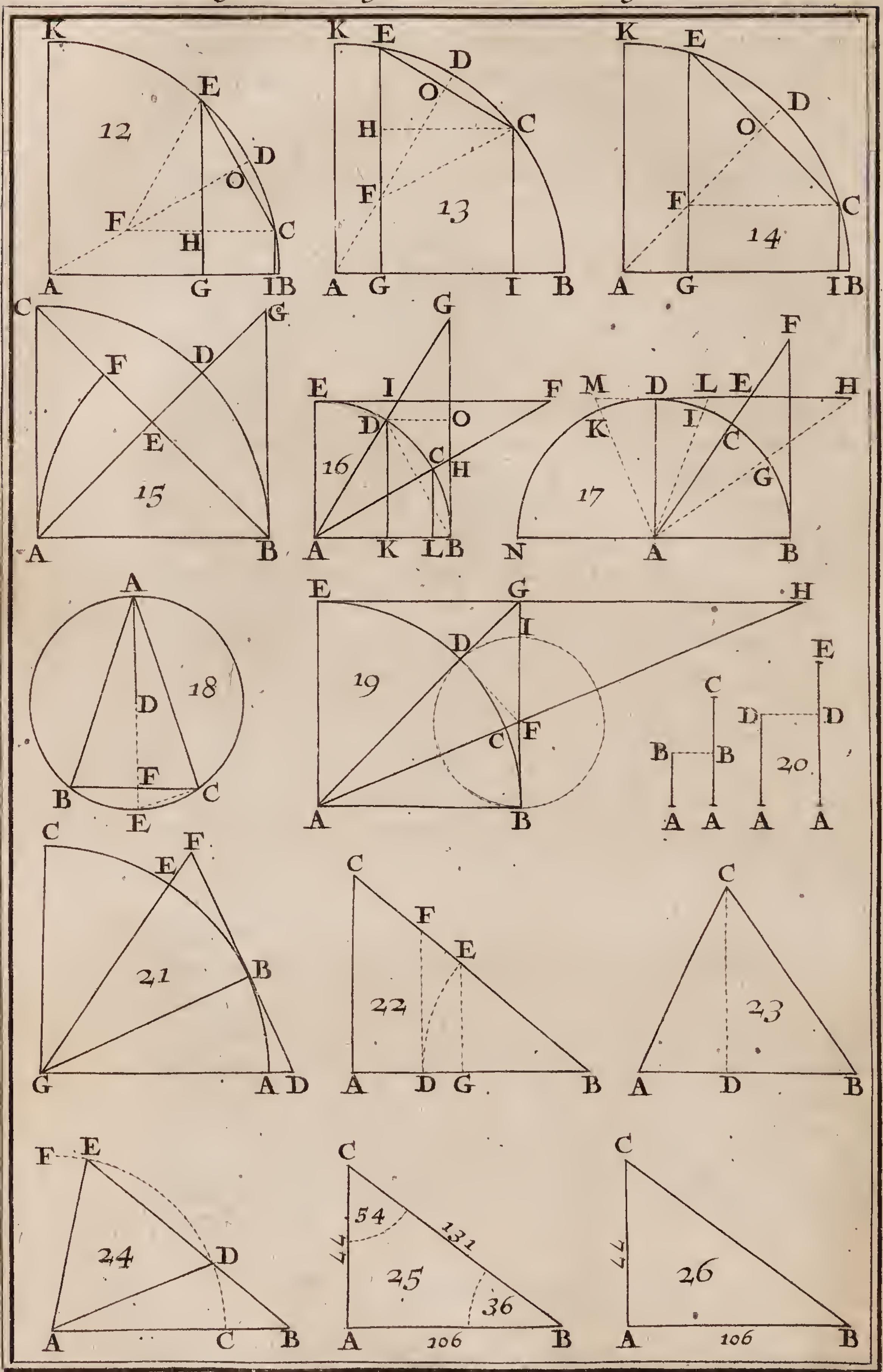
Lastly, it is evident, that the first Quantity a of the Column F is o, because it represents the first Number of of the same Column F of the first Table, and that thus the four Quantities a, b, c, d, being known, all the Quantites of the Column F of the Analytical Table, are also known, and consequently the Sine of a Minute, and of the others to 20.

SCHOLIUM.

This Method is pretty exact for the number of Places which we have assign'd to the Radius, and you may very usefully apply it to find the Sines of Seconds for a greater Radius, and also to find the Logarithms of decimal Fractions, because these Logarithms are essentially in a Compound Arithmetical Progression.

What

Trigonometry Plate 2. Page 31.



What we have said hitherto is sufficient for the Construction of the Canon of Sines of all the Minutes of the Quadrant, because the Sines of the first Minutes being found, as was just now shewn, you may *by Prop.* 4. find the Sines of the other Arcs. But to lessen the trouble, several Compendiums were invented, which depend on the following Theorems.

PROPOSITION XII.

THEOREM.

The Square of the Difference of the Sines of two Arcs equally distant from 30 Degrees, is triple the Square of half the Difference of those two Arcs.

I Say that if the Arc BD is 30 Degrees, and that the two Arcs BC, BE, are equally distant from it, so that the Arc ED, or CD its equal, be half their Difference CE; the Square of the Difference of the Sines EG, CI, of these two Arcs BE, BC, is triple the Square of the Sine CO or EO, of the half CD or DE, of their Difference CE. Plate 2. Fig. 12.

DEMONSTRATION.

If you draw from the Point C, the Line CF parallel to the Radius AB; and if thro' the Point F, where it cuts the Radius AD, you draw to the Point E the Right-Line EF, it will appear that EH is the Difference of the two Sines EG, CI, and that the Triangle EFC is equilateral. From whence it follows, that the Side CE being double CO, the Square CE, or *by* 47. 1. the two Squares EH, CH, are quadruple the Square CO: Wherefore by substracting from each Side the Square CH equal to the Square CO, it will appear that the single Square EH is triple the Square CO. *Which was to be Demonstrated.*

COROLLARY.

It follows from this Theorem, that if you have once computed the Sines to 30 Degrees, they may be easily computed to 60 Degrees; for if you know the Sines CI, CO, of the two Arcs BC, CD, which together make 30 Degrees, the Square Root of triple the Square of CO, namely EH, being added to the Sine CI, or GH its equal, you will have the Sine EG of the Arc BE, which is as much above 30 Degrees as the Arc BC is under.

PROPOSITION XIII.

THEOREM.

The Difference of the Sines of two Arcs equally distant from 60 Degrees, is equal to the Sine of half the Difference of those two Arcs.

Plate 1. Fig. 13.

I Say that if the Arc BD is 60 Degrees, and that the two Arcs BC, BE are equally distant from it, so that the Arc ED, or CD its equal be half their Difference CE; the Difference of the Sines CI, EG, of the two Arcs BC, BE, is equal to the Sine EO or CO, of the half CD or DE, of their Difference CE.

DEMONSTRATION.

If you draw from the Point C the Line CH, parallel to the Radius AB; and to the Point F, where the Radius AD is intersected by the Sine EG, the Right-Line CF; it will appear that the Triangle ECF is equilateral, and that the Line EH, or the Sine EO, or CO, is the Difference of the Sines EG, CI. *Which was to be Demonstrated.*

COROLLARY.

It follows from this Theorem, that having once found the Sines to 60 Degrees, you may find by Addition only, the Sines of the other 30 Degrees which remain of the Quadrant: For if you know the Sines CI, CO, of the Arcs BC, CD, which together make 60 Degrees, by adding together those two Sines CI, CO, you will have the Sine EG of the Arc BE, which is as much above 60 Degrees, as the Arc BC is under; as if the Arc BC were 40 Degrees, the Sine whereof is 6427876.10, and the Arc CD consequently 20 Degrees, the Sine whereof is 3420201.43, by adding together these two Sines you will have 9848077.53, for the Sine EG of the Arc EB 80 Degrees.

PRO-

PROPOSITION XIV.

THEOREM.

The Square of the Difference of the Sines of two Arcs equally distant from 45 Degrees, is double the Square of the Sine of half the Difference of those two Arcs.

I Say that if the Arc BD is 45 Degrees, and if the two Arcs BC, BE are equally remote from it, so that the Arc ED, or CD its equal, is half their Difference CE; the Square of the Difference of the Sines EG, CI, of the two Arcs BC, BE, is double the Square of the Sine EO, or CO, of the half CD or DE, of their Difference CE. Plate 2. Fig. 14.

DEMONSTRATION.

Having drawn from the Point C to the Point F, where the Sine EG is found cut by the Radius AD, the Right-Line CF, it will appear that this Line CF is parallel to the Radius AB, or perpendicular to the Sine EG, and that consequently EF is the Difference of the Sines EG, CI, and that EFC is an Isosceles Rightangled Triangle; from whence one may conclude that the Rightangled Triangle EFO is also Isosceles, and that *by* 47. 1. the Square EF being equal to the two equal Squares EO, OF, is double each. *Which was to be Demonstrated.*

COROLLARY.

It follows from this Theorem, that if to the Square Root of double the Square of the Sine of an Arc less than 45 Degrees, you add the Sine of the Remainder of this Arc to 45 Degrees, you will have the Sine Complement of this Remainder, it being certain that the Arc BE is the Complement of the Arc BC, because this Arc BC is equal to the Arc EK, which is the Remainder of the Arc EB to a Quadrant BK, because of the two equal Arcs CD, DE, and of the two equal ones BD, DK, &c.

PRO-

PROPOSITION XV.

THEOREM.

The Square of the Radius is double the Square of the Sine of 45 Degrees.

Plate 2. Fig. 15. I Say that if the Arc BD or CD is 45 Degrees, in which case BCD is a Quadrant, the Square of the Radius AB is double the Square of the Sine BE or CE, of the Arc BD or CD of 45 Degrees.

DEMONSTRATION.

Since the Rectangled Triangle ABC is Isosceles, it is easy to conclude that the Rectangled Triangle ABE is also Isosceles: and as *by* 47. 1. the Square AB is equal to the two equal Squares AE, BE, it will be double each. *Which was to be demonstrated.*

COROLLARY.

It follows from this Proposition, that if you take the Square Root of half the Square of the Radius, you will have the Sine of 45 Degrees. Thus, as we have suppos'd the Radius to consist of 10000000.00, its Square will be 100000000000000.0000, the half of this Square will be 50000000000000.0000, whose square Root 7071067.82, is the Sine of 45 Degrees.

PROPOSITION XVI.

THEOREM.

The Sine of an Arc is a mean Proportional between half the Radius, and the versed Sine of the double Arc.

Plate 1. Fig. 8. I Say that the Sine DE or BH of the Arc BD, is a mean Proportional between half the Radius AB, and the versed Sine BG of the Arc BF, which I suppose double the Arc BD, that is to say, half the Radius AB is to the Sine BH, as the Sine BH is to the versed Sine BG.

DEMON-

DEMONSTRATION.

It is evident *by* 32. 1. that the two Rectangled Triangles ABH, BFG, which have a common Angle B, are equiangular, and that *by* 4. 6. AB is to BH, as BF is to BG; wherefore by taking the halves of the Antecedents AB, BF, it will appear that the half of AB is to BH, as the half of BF, which is also BH, is to BG. *Which was to be Demonstrated.*

COROLLARY.

It follows from this Theorem, that the Square of the Sine of an Arc is equal to the Product under half the Radius, and the versed Sine of the double Arc, *by* 17. 6. and that consequently if you multiply the versed Sine of an Arc by half the Radius, the square Root of the Product will give the Sine of half that Arc.

PROPOSITION XVII.

PROBLEM.

To find the Sine of an Arc of 36 Degrees.

WE may find the Sine of 36 Degrees by getting the Chord of 72 Degrees, or the Side of a regular Pentagon, thus. Plate 2. Fig. 18.

We have discover'd in the Tenth Proposition of the Fourth Book of *Euclid*'s Elements, that the Base BC of the Isosceles Triangle ABC inscrib'd in a Circle whose Radius is DA, and where each of two Angles at the Base BC is double the third Angle A, is the Side of a regular Pentagon, or the Chord of 72 degrees; and in in the Eleventh Proposition of the Second Book of the same *Euclid*'s Elements, we have shewn that the Side AB or AC being 100000 Parts, the Base BC contains 61803 Parts of them; and its half CF consequently 30901, which is the Sine of 18 degrees, with respect of the Radius AB 100000.

This being suppos'd, produce the Radius AD to the Circumference of the Circle in E, to have the whole Diameter AE, which will cut the Base BC at Right-Angles and in two equal parts at the Point F, and draw the Chord CE, which will be perpendicular to the Side AC, *by* 31. 3.

If

if from the Square AC, which is 10000000000, you ſubſtract the Square CF, which is 954871801, the Remainder 9045128199 will be *by* 47. 1. the Square AF, wherefore by taking the ſquare Root of this Remainder, you will have 95105 for the Perpendicular AF, by which dividing the ſame Square 954871801 of the Line CF, the Quotient 10040 will be the Line EF, becauſe the Line CF is a mean Proportional between the two AF, EF, *by* 8. 6. ſo that their Rectangle will be equal to the Square CF, *by* 17. 6. and alſo by 35. 3. Thus by adding together the found values 95105, 10040, of the two Lines AF, EF, you will have 105145 for the Diameter AE, and conſequently 52573 for the half, or for the Radius AD. We find then that the *Radius* AD being 52573 parts, the Chord BC of 72 degrees contains 61803 parts, of them, and to find the quantity of this Chord for the Radius AD of 10000000 parts, ſuch as we have ſuppos'd, you muſt ſay by the Rule of Three, If 52573 gives 61803, how much will 10000000 give? and you will find 11755654. for the Chord BC of 72 degrees, whoſe half 5877827 will be the Sine of 36 degrees.

CHAP. II.

Of the Computation of Tangents.

THE Canon of Tangents is eaſily computed by means of the Canon of Sines, as you will ſee in the following Propoſitions.

PROPOSITION I.

PROBLEM.

To find the Tangent of an Arc whoſe Sine and Sine Complement are given.

Plate I. Fig. I. TO find the Tangent DI of the Arc DF, whoſe Sine FG, and Sine-Complement FN or AG, are given; multiply the Sine FG by the Radius AD, and divide the Product by the Sine-Complement AG; becauſe the Tangent DI is a fourth Proportional to the Sine-Complement AG,

AG, the Sine FG, and the Radius AD, *by* 4. 6. because of the right-angled Similar Triangles AGF, ADI, which have a common Angle A, *&c.*

PROPOSITION II.

THEOREM.

The Radius is mean proportional between the Tangent of an Arc, and the Tangent of its Complement.

I Say that the Radius AD, or AC, is a mean proportional between the Tangent DI, of the Arc DF, and the Tangent CH, of the Complement CF, that is to say, the Tangent DI, is to the Radius AD, as the Radius AC, is to the Tangent CH, because of the Similitude of the right angled Triangles ADI, ACH, whose alternate Angles AID, CAI, are equal, *by* 29. 1. because of the two Parallels AC, DI, *&c.*

COROLLARY.

From this Proposition you may find the Tangent of the Complement of an Arc, whose Tangent is given, namely by dividing the Square of the Radius by the given Tangent.

PROPOSITION III.

THEOREM.

The Tangents of two Arcs are reciprocally proportional to the Tangents of their Complements.

I Say that the Tangent BH of the Arc BC, is to the Tangent BG of the Arc BD, reciprocally as the Tangent EI of the Complement of the same Arc BD, is to the Tangent EF of the Complement of the first Arc BC. Plate 2. Fig. 16.

DEMONSTRATION.

Since the Radius AB is a mean proportional between the Tangent BH, and the Complement Tangent EF, and in like manner between the Tangent BG, and the Complement Tangent EI, *by Prop.* 2. it follows that the Rectangle under the two first Tangents BH, EF, is equal to the Rectangle under the two others BG, EI, because each is equal to the

Square of the Radius AB, *by* 17 6. wherefore by 14. 6. the four lines BH, BG, EI, EF, are proportionals. *Which was to be demonstrated.*

COROLLARY.

This Proposition affords another way of finding the Complement Tangent of an Arc, when the Tangent of that Arc is given, and that of another Arc, with its Complement Tangent; namely by multiplying the Tangent of this other Arc by that of its Compliment, and dividing the Product by the Tangent of the propos'd Arc.

PROPOSITION IV.

THEOREM.

The Tangent of an Arc of 60 Degrees is double its Sine, and triple the Tangent of an Arc of 30 Degrees.

Plate 2. Fig. 16. FIRST I say, that if the Arc BD be 60 Degrees, its Tangent BG is double its Sine DK.

DEMONSTRATION.

For if you draw the right line DO, parallel to the Radius AB, or perpendicular to the Tangent BG, and the Chord BD, which will be equal to the Radius AB, *by* 15. 4. it will appear that the Triangle BDG is Isosceles, because each of its two acute Angles is 30 degrees, and consequently the Base BG is double its Segment BO, or the Sine DK. *Which was to be demonstrated.*

I say in the second place, that if the Arc BC is 30 Degrees, in which case the Angle BAG will be divided into two equal Parts by the right line AH, because the Angle BAH is suppos'd to be 30 Degrees, and the Angle BAG 60; the Tangent BG is triple the Tangent BH.

DEMONSTRATION.

Since the line AH divides the Angle BAG into two equal parts, the four lines AG, AB, GH, BH, will be proportionals, *by* 3. 6. and because the antecedent AG is double its consequent AB, as we shall shew in *Prop.* 5. *Chap.* 3 the antecedent GH will be also double its consequent BH; wherefore the whole BG will be triple BH. *Which remain'd to be demonstrated.*

COROL-

COROLLARY.

It follows from this Theorem, that if you double the Sine of 60 Degrees, you will have its Tangent, and that you'll have it also by tripling the Tangent of 30 Degrees. From whence it is easy to conclude that the Tangent of 30 Degrees is to the Sine of 60 Degrees, as 2 is to 3. Wherefore you will have the Tangent of 30 Degrees, by taking the third of double the Sine of 60 Degrees.

PROPOSITION V.

THEOREM.

The Tangent of an Arc of 45 Degrees, is equal to the Radius.

I Say that if the Arc AF of a Circle whose Centre is B, is 45 Degree, its Tangent AC is equal to the Radius AB. Plate 2. Fig. 15.

DEMONSTRATION.

For since the Arc AF is 45 Degrees, the Angle B which it measures, is also 45 Degrees, and since the Angle A of the Triangle ABC is a right one, the Angle C *by* 32. 1. must also be 45 Degrees, and *by* 6. 1. the two Sides AB, AC of the right-angled Triangle ABC, must be equal to each other. *Which was to be demonstrated.*

COROLLARY.

It follows from this Proposition, that the Tangent of an Arc greater than 45 Degrees is greater than the Radius, and that the Tangent of an Arc less than 45 Degrees is less than the Radius.

PROPOSITION VI.

THEOREM.

The difference between the Tangent of an Arc, and that of its Complement, is double the Tangent of the difference of these two Arcs.

I Say that the difference between the Tangent BF of the Arc BC, and the Tangent DE of its complement CD, Fig. 17.

Plate 2. Fig. 17. is double the Tangent of the difference of these two Arcs BC, CD, that is to say, if you make the Arc DG equal to the Arc BC, in which case the Tangent DH of the Arc DG will be equal to the Tangent BF of the equal Arc BC, and consequently EH will be the difference of the Tangents of the two Arcs BC, CD, whose difference is CG, which being set off from D on both sides on the circumference of the Circle to the Points I, K, you have the two equal Tangents DL, DM, of this difference DI, or DK, or CG; the difference EH of the Tangents will be equal to double the Tangent DL, or DM, that is to say, equal to the line LM.

DEMONSTRATION.

If from the two equal Arcs BC, DG, you substract the common Arc CG, there will remain the Arc BG equal to the Arc CD, or GI, and consequently the Angle BAH, or its alternate AHD, equal to the Angle HAL, so that, *by* 6. 1. the line LH is equal to the Secant AL or AM. In like manner if to the two equal Arcs BG, CD, you add the equal Arcs CG, DK, it will follow that the Arc BC is equal to the Arc CK, and consequently the Angle BAE, or its alternate AEM equal to the Angle EAM, so that, *by* 6. 1. the line EM is equal to the Secant AM, or AL, or LH, wherefore if from these two equal lines EM, LH, you substract the common line EL, there will remain LM equal to EH. *Which was to be demonstrated.*

COROLLARY.

It follows from this Proposition, that the Tangent of an Arc of 60 degrees is triple the Tangent of an Arc of 30 degrees, as we have already shewn in *Prop.* 4. and that if to double the Radius, you add the Tangent of an Arc of 22°. 30′. you will have the Complement Tangent of this Arc, that is to say, the Tangent of an Arc of 67°. 30′.

It follows also, that having computed the Tangents of the Arcs less than 45 degrees, you may have, by Addition only, the Complement Tangent of an Arc less than 45 degrees, and greater than 22°. 30′, namely by adding to the Tangent of the propos'd Arc, double the Tangent of twice the remainder of this Arc from 45 degrees.

PRO-

PROPOSITION VII.

PROBLEM.

The Tangent of an Arc being given, to find the Tangent of half that Arc.

TO find the Tangent BF of the Arc BC, half the Arc BD, whose Tangent BG is given; add to the Square of this given Tangent BG, the Square of the Radius AB, and the sum will be the Square of the Secant AG, *by* 47. 1. And by extracting the Square Root of this Sum, you will have the Secant AG, then say Plate 2. Fig. 19.

As the Sum of the given Secant and Radius,
Is to the Radius;
So is the given Tangent,
To the Tangent of half the Arc.

DEMONSTRATION.

Since the line AF divides the Angle BAG into two equal parts, it is apparent, *by* 3. 6. that the four lines AG, AB, GF, BF, are proportionals: Wherefore by compounding them, these four Quantities AG+AB, AB, BG, BF, are also proportionals; *Which was to be demonstrated.*

PROPOSITION VIII.

PROBLEM.

The Tangent of an Arc being given, to find the Tangent of double that Arc.

IF the Tangent BF of the Arc BC is given, you may find the Tangent BG of the double Arc BD, by this Analogy, Fig. 19.

As the difference of the Square of the Radius and given Tangent,
Is to the Square of the Radius;
So is double the given Tangent,
To the Tangent of double the Arc.

DEMONSTRATION.

Plate 2. Fig. 19.

If you draw the right line FD, which will be a Tangent equal to the Tangent BF, by reason of the equality of the two Arcs BC, CD, and if from the point F, as the Centre, you describe thro' the two points B, D, the circumference of the Circle BDI, which will be touch'd in D, by the Radius AD by reason of the right Angle D, it will appear *by* 32. 1. that the two right-angled Triangles ABG, FDG, are equiangular, because they have the Angle G common, and *by* 4. 6. the four lines AB, FD, BG, GD, are proportionals, and also their Squares *by* 22. 6. and because the Square GD, is equal to the rectangle under BG, and GI, *by* 36. 3. it will follow that the Square AB, the Square FD, or BF, the Rectangle under BG, GI, and the Square BG are proportionals: And because the Square BG, and the Rectangle of BG, GI, are two Parallelograms, whose common heighth is BG, and which are *by* 1 6. to each other, as their Bases BG, GI, it follows that the Ratio of the two Squares AB, BF, is equal to that of the two lines BG, GI wherefore *by conversion*, there is the same Ratio of the difference of the Squares AB, BF, to the Square AB, as of the line BI, or of double the Tangent BF, to the Tangent BG. *Which was to be demonstrated.*

PROPOSITION IX.

PROBLEM.

To find the Tangent of an Arc of 22°. 30′.

Fig. 19.

IF the Arc BD is 45 degrees, in which case its Tangent BG, will be equal to the Radius *by Prop.* 5. and if the Arc BC be 22°. 30′. which is half the Arc BD, you will find its Tangent BF, or DF, by substracting the Radius AD from the Chord AG of 90 degrees, which is given, because *by Def* 16. it is double the Sine of 45 degrees, for the remainder will be the Tangent BF, because this Tangent BF, or DF is equal to the line DG, *by* 6. 1. since the Angle G of the right-angled Triangle FDG, being semi-right, or of 45 degrees, by reason of the semi-right-angle BAG, the Angle DFG, is also semi-right, and consequently equal to the Angle G, *&c.*

SCHO-

SCHOLIUM.

We have obſerv'd in *Prop* 7. that if to double the Radius AB, you add the Tangent BF of 22°. 30′. you will have the Complement Tangent EH, or the Tangent of 67°. 30′, and we ſhall obſerve here that if to the Radius AB, or EG, you add the double AG, or GH, its equal, of the Sine of 45 degrees, you will have the ſame complement Tangent EH.

CHAP. III.

Of the Computation of Secants.

BY the means of the Canon of Sines and Tangents it will be alſo eaſy to conſtruct the Canon of Secants, as you will find in the following Propoſitions, where you will have uſeful Compendiums for the finding of theſe Lines.

PROPOSITION I.

PROBLEM.

The Tangent of an Arc being given, to find its Secant.

IT is evident *by* 47. 1. that to find the Secant AF of the Arc BC, whoſe Tangent BF is given, there is nothing to do, but to add the Square of this Tangent BF to the Square of the Radius AB, and extract the Square Root of the Sum. Plate 2. Fig. 19.

PROPOSITION II.

THEOREM.

The Radius is a mean proportional between the Sine complement of an Arc, and the Secant of that Arc.

I Say that of the Arc BD, if the Secant is AG, and the Sine Complement AK, with reſpect to the Radius AB, Fig. 16.

or AD, this Radius AB, or AD, is a mean proportional between the Secant AG, and the Sine complement AK.

DEMONSTRATION.

Since the two Triangles AKD, ABG, are right-angled in K and in B, and since they have the angle A common, they are equiangular *by* 32. 1. and *by* 46. the four lines AK, AD, AB, AG, are proportionals. *Which was to be demonstrated.*

COROLLARY.

It follows from this Proposition, that to find the Secant of an Arc, whose Sine complement is given, you need only divide the Square of the Radius by this Sine complement. From whence it is easy to conclude that to find the Secant complement of an Arc, whose Sine is given, you must di-divide the Square of the Radius by this Sine.

PROPOSITION III.

THEOREM.

The Secants of two Arcs are reciprocally proportional to the Sines of their Complements.

Plate 2. Fig. 16.

I Say that the Secant AF of the Arc BC, is to the Secant AG of the Arc BD, reciprocally as the Sine complement AK of the same Arc BD, is to the Sine complement AL of the first Arc BC.

DEMONSTRATION.

Since the Radius AB is a mean proportional between the Secant AG and the Sine complement AK, and in like manner between the Secant AF and the Sine complement AL, *by Prop.* 2. it follows that the Rectangle under the Secant AG and the Sine complement AK, is equal to the Rectangle under the Secant AF, and the Sine complement AL, because each is equal to the Square of the Radius AB, *by* 17. 6. wherefore *by* 14. 6. the four lines AF, AG AK, AL, are proportionals. *Which was to be demonstrated.*

COROL-

COROLLARY.

This Proposition teaches likewise to find the Secant of an Arc, when its Sine complement, and the Secant of another Arc, and also its Secant complement are given, namely by multiplying the Secant of this other Arc by its Sine complement, and dividing the Product by the Sine complement of the propos'd Arc.

SCHOLIUM.

You may otherwise more easily find the Secant of an Arc, by means of the Canon of Tangents alone, namely by Addition only, thus. We have shewn in *Prop*. 6. *Chap*. 2. that the Secant AM of the difference of the Arc BC, and of its complement CD, is equal to the Sum ME of the Tangent DM of the same difference, and of the Tangent DE of the same complement. Wherefore to find the Secant of a given Arc, for example of 10 degrees, you must seek for two Arcs whose difference is 10, and whose sum is always 90, which may be done by adding together 90 and 10, and half the Sum 100, namely 50 will be the greatest of these two Arcs, whose complement 40 will be the other Arc, whereof the Tangent is 8390996, to which adding the Tangent 1763270 of the given Arc 10 degrees, the Sum 10154266 will be the Secant of the same Arc 10 degrees. Plate 2. Fig. 17.

We have also shewn in the same place, that the Secant AL of the difference of two Arcs, BC, and of its complement CD, is equal to the line LH, which is the difference between the Tangent DL of the same difference, and the Tangent DH of the same complement CD, or BG. Wherefore to find the Secant of a given Arc, as suppose 10 degree; having found as before the two Arcs 40 and 50 degrees. You must substract from the Tangent 11917536 of the greatest of these two Arcs, the Tangent 1763270 of the given Arc 10 degrees, and there will remain as before, 10154266 for the Secant of the same given Arc of 10 degrees.

Thus by Addition only you may find, two several ways, the Secant of a given Arc, but there is a third way much shorter, which we shall explain in the following Proposition, after having said that from the first of these two methods it follows that the Secant of an Arc of 30 degrees is double its Tangent, and that from the second manner it follows that the same Secant is equal to the difference be-

tween its Tangent, and its Tangent complement, or Tangent of 60 degrees.

PROPOSITION IV.

THEOREM.

The Secant of an Arc is equal to the Sum of its Tangent, and the Tangent of half its complement.

Plate 2. Fig. 21. I Say that in the Arc AB, whose Secant is GD, Tangent BD, and complement BC, its half is BE, whose Tangent is BF; this Secant GD, is equal to the Sum of the Tangents BD, BF, that is to say, to the line DF.

DEMONSTRATION.

Since the Angle F is the complement of the Angle BGF, by reason of the right Angle B and that in like manner the Angle FGD is the complement of the same Angle FGB, or of its equal CGF, by reason of the right Angle CGD, it follows that the Angle F is equal to the Angle FGD, and that *by* 6. 1. the two lines DF, DG, are equal. *Which was to be demonstrated.*

COROLLARY.

This Proposition teaches to find the Secant of an Arc, whose Tangent, and the Tangent of half its complement is known; namely by adding together these two Tangents.

From whence you may also conclude that the Secant of an Arc of 30 degrees is double its Tangent.

PROPOSITION V.

THEOREM.

The Secant of an Arc of 60 degrees is double the Radius, and the Secant of an Arc of 45 degrees is double its Sine.

Fig. 16. FIRST I say that if the Arc BD be 60 degrees, its Secant AG is double the Radius AB, or AD.

DEMONSTRATION.

Since the Tangent BG is double the Sine DK, or BO, *by Prop.* 4. *Chap.* 2. then it necessarily follows *by* 2. 6. that

that the Secant AG ſhou'd be alſo double the Radius AD. *Which was to be demonſtrated.*

I ſay in the ſecond place, that if the Arc BD is 45 degrees, the Secant AG is double its Sine BE or CE. Plate 2. Fig. 15.

DEMONSTRATION.

The two right angled Triangles ABG, BAC having the two Sides AB, BG, equal to the two AB, AC, the Baſes AG, BC, will be equal to each other, *by* 4. 1. and as BC is double the Sine BE, it neceſſarily follows that AG ſhou'd alſo be double BE. *Which was to be demonſtrated.*

PROPOSITION VI.

PROBLEM.

The Tangent and Secant of an Arc being given, to find the Secant of half that Arc.

If the Tangent BG, and the Secant AG of the Arc BD be given, you will find the Secant AF of the half BC, by ſeeking firſt for its Tangent BF, *by Prop.* 7. *Chap.* 2. and adding the Square of this Tangent BF, to the Square of the Radius AB, for the Square Root of the Sum will *by* 47. 1. be the Secant AF of the half BC of the given Arc BD. Fig. 19.

PROPOSITION VII.

PROBLEM.

The Tangent and Secant of an Arc being given, to find the Secant of double that Arc.

If the Tangent BF, and the Secant AF of the Arc BC be given, you will find the Secant AG of the double Arc BD, by ſeeking firſt for its Tangent BG, *by Prop.* 8. *Chap.* 2. and adding the Square of this Tangent BG, to the Square of the Radius AB, for the Square Root of the Sum will *by* 47. 1. be the Secant AG of the double BD of the given Arc BC; which may more be eaſily found by this Analogy, Fig. 19.

As

As the difference between the Squares of the Radius and given Tangent,
Is to the Square of the given Secant,
So is the Radius,
To the Secant of the double Arc.

DEMONSTRATION.

Fig. 19. Since *by Prop.* 8. *Chap.* 2. you have this Analogy $ABq - BFq : ABq :: 2BF : BG$, if you take the halves of the antecedents, you will have this $\frac{1}{2}ABq - \frac{1}{2}BFq : ABq :: BF : BG$, and *by conversion* you have this $\frac{1}{2}ABq - \frac{1}{2}BFq : \frac{1}{2}AFq :: BF : FG$, and lastly if instead of the two first terms, you put their double, and instead of the two last BF, FG, the two AB, AC, which are in the same Ratio *by* 36, you will have this last Analogy, $ABq - BFq : AFq :: AB : AG$. *Which was to be demonstrated.*

CHAP. IV.

Of the Computation of Logarithms.

LOgarithms are numbers in Arithmetical Progression, which correspond to as many other numbers in Geometrical Progression, whence they are call'd *Logarithms*, and are also call'd *Artificial Numbers*, because by an admirable artifice they are most conveniently us'd in the practice of the Rule of Three, without the Trouble of any Multiplication, or Division, namely by changing Multiplication into Addition, and Division into Substraction; which is extremely useful in the calculation of Spherical Triangles, where you cannot do without large numbers, the Multiplication and Division whereof would be exceeding laborious without the help of these Logarithms; the Construction of which we shall here teach in such a method as seems to me shortest and easiest, such as we have formerly publish'd in the *Tables of Sines*, printed at *Lyons*, Anno 1670.

PROPOSITION I.

PROBLEM.

To explain the Nature and Origin of Logarithms.

TO leave nothing for conjecture, we ſhall firſt ſay that *Progreſſion* in general, is a Series of Quantities, call'd *Terms of the Progreſſion,* increaſing or decreaſing in the ſame manner; and when this augmentation or diminution is made by continual Addition or Subſtraction of one and the ſame Quantity, which is call'd *Exceſs of the Progreſſion,* then it is call'd *Arithmetical Progreſſion,* as 1, 2, 3, 4, *&c.* or 1, 3, 5, 7, 9, *&c.* the firſt whereof, being the ſimpleſt of all, ſhall ſerve us for the finding of Logarithms. But when this augmentation or diminution is made by continual Multiplication, or Diviſion by one and the ſame number, which we ſhall call *Exponent of the Progreſſion,* then it is call'd *Geometrical Progreſſion*; this is call'd *Double Progreſſion,* when the Exponent is 2; as 1, 2, 4, 8, 16, *&c. Triple Progreſſion,* when the Exponent is 3, as 1, 3, 9, 2, 7, 81, *&c.* and ſo of the reſt, among which the ſimpleſt and eaſieſt is that when the Exponent is 10, and which for that reaſon is call'd *Decimal Progreſſion,* as 1, 10, 100, 1000, 10000, *&c.* which we ſhall conſequently uſe for the computation of Logarithms: Such a Progreſſion, and all the reſt which gradually encreaſe are call'd *ſubmultigle Progreſſion*; and that which gradually diminiſhes is call'd *multiple Progreſſion,* as 8, 2, $\frac{1}{2}$, $\frac{1}{8}$, $\frac{1}{32}$, *&c.* whoſe Exponent is 4. What gave occaſion to the Invention of Logarithms is the difference which is found between theſe two ſorts of Arithmetical and Geometrical Progreſſions, which is, that in the four ſucceſſive Terms of an Arithmetical Progreſſion, the Sum of the two Extreams is equal to the Sum of the two Means, as will appear in the following Propoſition: When in Geometrical Progreſſion, the Sum of the two Extreams is greater than the Sum of the two Means, *by* 25. 5. But inſtead of the Sum, it happens in this Progreſſion, that the Product of the two Extreams is equal to the Product of the two Means, *by* 16. 6. From whence it follows, that to find the fourth Term Geometrically proportional, multiply the ſecond and third, and divide the Product by the firſt; and to find the fourth Arithmetically proportional Term, add the ſecond and third, and ſubſtract the firſt from their Sum; where it appears that Multiplication is chang'd into Addition, and Diviſion

into

into Subſtraction, when you work by numbers in an Arithmetical Progreſſion, which for that reaſon were call'd *Logarithms*, with regard to the numbers in a Geometrical Progreſſion, which they repreſent.

Since it is indifferent what Progreſſion is us'd, we ſhall take the Decimal Progreſſion 1, 10, 100, 1000, 100000, *&c.* for the Geometrical Progreſſion, and the Progreſſion of natural Numbers, 1, 2, 3, 4, 5, *&c.* for the Arithmetical one, ſo that the firſt Geometrical Number, 1, hath 0 for its Logarithm, to render the uſe of Logarithms more eaſy, as you ſee in the followiug Table, where the Logarithm of

Geom. Progr.	*Arithm. Progr.*
1	0.0000000
10	1.0000000
100	2.0000000
1000	3.0000000
10000	4.0000000
100000	5.0000000
1000000	6.0000000
10000000	7.0000000
100000000	8.0000000
1000000000	9.0000000
10000000000	10.0000000

Unity is 0, the Logarithm of 10 is 1, the Logarithm of 100, is 2, the Logarithm of 1000 is 3, the Logarithm of 10000 is 4, and ſo on. From whence it follows that the Logarithm of a Fraction, or of a Number leſs than Unity is leſs than 0, and ſuch a Logarithm is call'd *Defective Logarithm*, which is properly what in Algebra we have call'd *Negative Number.*

It likewiſe follows that all the Logarithms of Numbers which are between 10 and 100, ought to begin with 1; that all thoſe of Numbers which are between 100 and 1000, ought to begin with 2; and all thoſe of Numbers which are between 1000 and 10000, ought to begin with 3; and ſo on according to the order of the natural Numbers, 1, 2, 3, 4, *&c.* which in this caſe are call'd the *Characteriſtic* or the *Indices* of the Logarithms, with which they begin and are ſeparated by a Point, to ſhew that the other Figures on the right hand are Decimal Fractions.

From

From whence it again follows, that the Logarithms of the first Numbers between 1 and 10, encrease faster than those of the Numbers between 10 and 100, and these again faster than those of the Numbers between 100 and 1000, and so on, because between 1 and 10, there are 8 Numbers, instead of that between 10 and 100 there are 89; and 899 between 100 and 1000, and so on always more, and yet the Characteristics encrease equally.

To find the Logarithms of these intermediate Numbers, which you have need of in Practice; as these Logarithms cannot be express'd but by Fractions, you may also use the Decimal Progression, to facilitate the Calculation, by adding a certain Number of Cyphers to each suppos'd Logarithm of the Numbers of the Geometrical Progression, more or less according as you will have Logarithms more or less exact, it being impossible to have 'em all perfect, for example, seven Cyphers as in the preceding Tables, which does not change the Proportion. Supposing then that the Logarithm of 10 is 1.0000000, the Logarithm of 100 is 2.0000000 the Logarithm of 1000 is 3.0000000, &c. you must find from this supposition, the Logarithms of the intermediate Numbers 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, &c. which we shall do, after having explain'd and shewn some Properties of Logarithms, which are necessary to be known, as well to find 'em, as to use 'em.

PROPOSITION II.

THEOREM.

The Sum of the two Extreams of four Quantities in Arithmetical Proportion, is equal to the Sum of the two Means.

I Say that if the four Quantities AB, AC, AD, AE, be *Arithmetically proportional*, so that the excess BC of the second AC above the first AB, be equal to the excess DE of the fourth AE above the third AD; the Sum AB+AE, of the two extreams is equal to the Sum AC+AD of the two means. Plate 2. Fig. 20.

DEMONSTRATION.

The first Sum AB+AE is compos'd of the first Quantity AB, of the third AD and of the excess ED, and in like manner the second Sum AC+AD, is also compos'd of the first Quantity AB, of the third AD, and of the excess BC, which is suppos'd equal to DE; From whence it

fol-

follows that these two Sums are equal. *Which was to be demonstrated.*

COROLLARY.

It follows from this Proposition, that to three given Quantities to find a fourth Arithmetically Proportional, there needs no more but to substract the first from the Sum of the two others, since this Sum is equal to that of the first and of the fourth, which may be also found by adding to the third the excess of the second above the first, or by substracting from the third the excess of the first above the second.

PROPOSITION III.

THEOREM.

The Sum of the two extreams of three Quantities Arithmetically proportional is equal to the double of the mean.

IT is evident by the preceding Proposition, that the Sum of the two extreams of three Quantities Arithmetically proportional, is double the mean, because these three Quantities are equivalent to four, the two means whereof are equal to each other, so that their Sum which hath been shewn equal to that of the two extreams, is the double of each. *Which was to be demonstrated.*

COROLLARY.

It follows from this Proportion, that to two given Quantities to find a third Arithmetically proportional, there needs no more but to substract the first from the double of the second; and between two given Quantities to find an Arithmetical mean proportional, there needs no more but to take the half of their Sum.

PRO-

PROPOSITION IV.

THEOREM.

The Sum of the Logarithms of two whole Numbers is equal to the Logarithm of their Product, when the Logarithm of Unity is 0.

I Say that if the Logarithm of Unity is 0, the Sum of the Logarithm of any two whole Numbers, for Example 4, 6, is equal to the Logarithm of their Product 24.

DEMONSTRATION.

Because 24 is produc'd by the multiplication of these two numbers 4, 6, these four 1, 4, 6, 24, will be Geometrically proportional, and consequently their Logarithms are Arithmetically proportional: Wherefore by *Prop.* 2. the Sum of the Logarithms of the two extreams, 1, 24, that is to say the single Logarithm of 24, because the Logarithm of 1 is suppos'd equal to 0, will be equal to the Sum of the Logarithms of the two means 4, 6. *Which was to be demonstrated.*

SCHOLIUM.

This Theorem is also true in Fractions, but not in Whole numbers and a Fraction, for in this case the Sum of the Logarithm is chang'd into their difference, because the Logarithm of a Fraction being a Negative number, ought to be substracted, when you wou'd add it to an Affirmative number, such as is the Logarithm of a Whole number.

COROLLARY.

It follows from this Proposition that the Logarithm of a *Compound number*, that is to say, of a number which is produc'd by the Multiplication of several others, such as Plane numbers, Solids and more than Solids, is equal to the Sum of the Logarithms of all its Sides. Thus the Logarithm, for example, of 72 is equal to the Sum of the Logarithms of 3 and of 24, or of the Logaritms of 6 and of 12, or of the Logarithms of 8 and 9, or of the Logarithms of 3, 4, 6, or of the Logarithms 2, 3, 12, *&c.* From whence is easy to conclude, that the Logarithm of a Square num-

ber is double that of its Root, and that the Logarithm of a Cube number is triple that of its Root.

PROPOSITION V.

THEOREM.

The difference of the Logarithms of two Whole numbers is equal to the Logarithms of their Quotient, when the Logarithm of Unity is 0.

I Say that if the Logarithm of Unity is 0, the difference of the Logarithms of any two Whole numbers, for example, 6, 24, is equal to the Logarithm of their Quotient 4.

DEMONSTRATION.

Because by dividing 24 by 6, the Quotient is 4, it is plain that these four numbers 1, 4, 6, 24, are Geometrically proportional, and consequently their Logarithms Arithmetically proportional, whence the Logarithm of 24 is equal to the Sum of the Logarithms of 6 and 4, wherefore if from the Logarithm of 24 you substract the Logarithm of 6, the remainder will be the Logarithm of 4. *Which was to be demonstrated.*

SCHOLIUM.

This Theorem is likewise true in Fractions, but not in Whole numbers and a Fraction, for in this case the difference of the Logarithms is changed into their Sum, because the Logarithm of a Fraction being a Negative number, ought to be added, when you would substract it from an Affirmative number, such as is the Logarithm of a Whole number.

PROPOSITION VI.

THEOREM.

The Logarithm of any number is equal to half the Logarithm of its Square, and to a third of the Logarithm of its Cube, when the Logarithm of Unity is 0.

THis is a consequence of *Prop.* 4. where we have observ'd that the Logarithm of a square number is double that of its Root, and that the Logarithm of a Cube number is

triple

triple that of its Root. From whence it follows that to find the square Root of a number, take the half of its Logarithm, and you have the Logarithm of its square Root, and to find the Cube Root of a number, take the third of its Logarithm, and you have the Logarithm of it Cube Root.

PROPOSITION VII.

PROBLEM.

Between two numbers to find a Geometrical Mean proportional.

IF you multiply together the two given numbers, you will have the Square of the Mean requir'd, *by* 17. 6. wherefore by extracting the square Root of the Product, you will have this Mean. From whence it follows that when one of the two given numbers is Unity, there needs no more than to extract the square Root of the other, and you have the Mean requir'd, because multiplying by Unity does not alter the number which it multiplies.

PROPOSITION VIII.

PROBLEM.

To find an Arithmetical Mean proportional between two given numbers.

IF you add together the two given numbers, the Sum will be double the Mean requir'd, *by Prop.* 3. wherefore by taking half the Sum, you will have this Mean. From whence it follows that when one of the two given numbers is 0, as it happens in the following Problem, then take half the other.

PROPOSITION IX.

PROBLEM.

To find the Logarithm of a given number.

TO find the Logarithm of a given number, as of 9, which is between 1 and 10, whose Logarithms are 0.0000000, 1.0000000, or 0.00000000, 1.00000000, augmenting them each by a Cypher, to have the Logarithm

requir'd more exactly, because of the Fractions which remain after the last Figure; augment likewise the two numbers 1, 10, and all the rest of the Geometrical Progression, by as many Cyphers as their Logarithms contain, as here by seven Cyphers, to have the Logarithm of the given number 9, exact to so many Figures. So that 9 is equivalent to 9.0000000, as 1 is equivalent to 1.0000000, which we shall call A, and 10 as much as 10.0000000, which we shall call B, and do then

Find *by Prop.* 6. between A and B a geometrical Mean proportional C which is less than the propos'd number 9.0000000, wherefore to come nearer this number 9, you must search between the two nighest B and C, a second Mean proportional D, which being again less than the propos'd number 9.0000000, and nearer than the found number C, you must seek between the next D and the greatest B, a third mean proportional E, which being again less than the propos'd number 9.0000000, you must seek in like manner between the next E, and the greatest B, a fourth mean proportional F, which is again less than the propos'd 9.0000000, wherefore you must seek again between this next less F, and the greatest B, a fifth mean proportional G, which is found here greater than 9.0000000, then seek between this greatest G and the least F, a sixth mean proportional H, which is much less than 9.0000000, but not with such a great difference as F, thus between this next less H, and the next greatest G, seek a seventh mean proportional I, which is much greater than 9.0000000, but not with such a great excess as G, wherefore between this next greatest I, and the next less H, seek an eighth mean proportional K, which tho' greater than 9.0000000 still comes nearer than the preceding I. Thus by continuing to seek between the next less, and the next greatest of the Geometrical mean proportionals, you will have numbers which will always approach nigher and nigher the propos'd number 9.0000000, which at last is found here the twenty sixth Geometrical mean proportional, whose Logarithm will be known without trouble: For as between the numbers A, B, you have found a Geometrical mean proportional C, if between the Logarithms of the same numbers A, B, you seek *by Prop.* 8. an Arithmetical mean proportional, you will have the Logarithm of the Geometrical mean proportional C. In the same manner the Logarithms of other Geometrical mean proportionals are found out, and consequently the Logarithm of the last 9.0000000, or of the propos'd number 9, which is found to be 0.9542425 1, or 0,9542425, by cutting off the last Figure 1 towards the right hand, the

	Proport. Numb.	*Logarithms.*		*Proport. Numbr.*	*Logarithms.*
A	1.0000000	0.00000000	O	9.0021388	0.95434570
C	3.1622777	0.50000000	Q	9 0008737	0.95428467
B	10.0000000	1.00000000	P	8,9996088	0.95422363
B	10.0000000	1.00000000	Q	9.0008737	0.95428467
D	5.6234132	0.75000000	R	9.0002412	0.95415415
C	3.1622777	0.50000000	P	8.9996088	0.95422363
B	10.0000000	1.00000000	R	9.0002412	0.95428467
E	7.4989421	0.87500000	S	8.9999250	0.95421889
D	5.6234132	0.75000000	P	8 9996088	0.95422363
B	10.0000000	1.00000000	R	9.0002412	0.95428467
F	8.6596432	0.93750000	T	9 0000831	0.95424652
E	7.4989421	0.87500000	S	8 9999250	0.95423889
B	10.0000000	1.00000000	T	9.0000831	0.95424652
G	9.3057204	0.96175000	V	9.0000041	0.95324271
F	8.6596432	0 93750000	S	8.9999250	0.95423889
G	9.3057204	0.97875000	V	9.0000041	0.95424271
H	8.9768713	0.95312500	X	8.9999650	0.95424080
F	8 6496432	0.93750000	S	8.9999250	0.95423889
G	9.3057204	0.96875000	V	9.0000041	0 95424271
I	9.1398170	0.96093750	Y	8.9999845	0.95424217
H	8.9768713	0.95312500	X	8.9999650	0.95424080
I	9.1398170	0.96093750	V	9.0000041	0.95424271
K	9.0579777	0.95703125	Z	8.9999943	0 95424223
H	8 9768913	0.95312500	Y	8.9999845	0 95424217
K	9.0579777	0.05703125	V	9.0000041	0.95424271
L	9.0173333	0.95507812	&	8 9999992	0 95424247
H	8.9768713	0.65312500	Z	8.9999943	0.95424223
L	9 0173333	0.95507812	V	9.0000041	0 95524171
M	8.9970796	0.95410156	AA	9.0000016	0.95424259
H	8.9768713	0.95312500	&	8.9999992	0.95424247
L	9.0173333	0 95507812	AA	9.0000016	0.95434259
N	9.0072008	0.95458984	BB	9 0000004	0.95424253
M	8 9970796	0.95410156	&	8.9999992	0.95424247
N	9.0072008	0.95458984	BB	9 9000004	0 95424253
O	9.0021388	0 95434570	CC	8.9999998	0.05424250
M	8 9970796	0 95410156	&	8.9999992	0 95424247
O	9.0021388	0.95434570	BB	9.0000004	0.95424253
P	8.9996088	0,95422363	DD	9.0000000	0 95424251
M	8.9970796	0.95410156	CC	8.9999998	0.95424247

by reason of the supernumary Cypher, which we added at the beginning.

You will find in the same manner the Logarithms of the other numbers between 1 and 10, and of the numbers between 10 and 100, and in like manner of the numbers between 100 and 1000, and so on. But this Method shou'd be applyed only to *Prime Numbers*, that is to say, only to numbers which are not divisible by others, for when they are Compound, and you know the Logarithms of the two numbers which multiplied do produce them, it is evident, *by Prop.* 4. that the Sum of these two Logarithms will be the Logarithm of the compound Number. Thus having found the Logarithm of 9, the double of this Logarithm will be the Logarithm of 81, the Square of 9, and the half of the same Logarithm will be the Logarithm of 3, the square Root of 9, so of the rest. We shall speak more particularly of Logarithms in

CHAP. V.

Of the Use of the TABLES.

WE have added at the end of this first Book two great Tables of numbers, the first whereof contains the *Sines*, *Tangents*, and the *Secants*, with the Logarithms of the Sines and Tangents of all the Degrees and Minutes of the Quadrant, which are so dispos'd in each Page, that the Degrees and Minutes of one Page, make with the correspondent Degrees and Minutes of the other Page, which respects the first, always 90 degrees, and thus the one is the Complement of the other, which is very convenient in practice, where you have almost always need of the Complement of an Arc or of an Angle, which you find in the other Page opposite to the degrees and Minutes of this Arc, without the trouble of substracting them from 90 Degrees. Thus the Complement of an Arc or Angle of 35°. 16′. is 54°. 44′. and the Complement of an Angle of 50°. 20′. is 49°, 40′. *So of the rest.*

Each Page contains half a Degree, or 30 Minutes, which are mark'd at the side towards the left hand, and the Degrees at the top, with their Sines, Tangents and Secants, to the Radius 10000000, tho' only 100000 need be taken in small computations, such as commonly those in practical Geometry are, by cutting off two Cyphers, in which case you shou'd also cut off two Figures at the right hand

of each Sine, Tangent and Secant, which Figures, for this end, we have separated by a point, to shew that you must stop at this point, when you wou'd have the Sine, Tangent, or Secant of an Arc to a Radius of 100000 Parts.

As to the Logarithms of the Sines, and Tangents, they are to a Radius much greater, namely to 10000000000 parts, which evidently shews that by working by Logarithms, large calculations are not only more easy, but more exact.

We have omitted the Logarithms of the Secants, because they may be let alone in the practice, as you will find in the two following Books, where all the cases which may be resolv'd by the Secants, may be resolv'd also otherwise, namely by the Sines or Tangents.

The second Table contains the Logarithms of Natural numbers, from Unity to 10000, which is sufficient for the common calculations in *Practical Geometry*; and it is easy by what has been said, and by what we shall say in *Prob.* 5, to prolong it to Logarithms of 10000000, without any sensible error.

PROBLEM I.

To multiply two Whole numbers less than 10000.

IN the second Table look for the Logarithms of the two given nnmbers, and add these two Logarithms together, their Sum will be the Logarithm of the Product of the two given numbers, *by Prop.* 4. *Chap.* 4. Wherefore if you look for this Logarithm in the last Table, (and you will always find it there, provided it does not exceed 4.0000000, which is the Logarithm of the last and greatest number 10000 of the Table,) you will find opposite to it the number to which it belongs, for the Product required.

As to multiply these two numbers 144, and 64, whose Logarithms are 2.1583625, and 1.8061800, which being added together you have this Logarithm 3.9645425, to which answers in the Table the number 9216, for the Product of the two given numbers 144, and 64.

SCHOLIUM.

If the Sum of the two Logarithms be greater than 4.0000000, in which case you cannot find it in the last Table, then you will find to what number this Logarithm belongs *by Prob.* 11.

PROBLEM. II.

To divide a Whole number less than 10000, *by another.*

SEEK in the second Table the Logarithms of the two propos'd numbers, and from the Logarithm of the Dividend substract the Logarithm of the Divisor, and the remainder will be the Logarithm of the Quotient, *by Prop.* 5. *Chap.* 4. Wherefore if you seek this Logarithm in the last Table, or its nearest, you will find opposite to it the Quotient requir'd.

As to divide 9216, whose Logarithm is 3.9645425 *by* 64, whose Logarithm is 1.8061800, substracting this Logarithm from the preceding, and there remains this other Logarithm 2.1583625, to which answers in the second Table 144, for the Quotient sought.

SCHOLIUM.

When in the Quotient there happen to be a Fraction, it will be discover'd by the Logarithm requir'd in the Table, not being found exactly there, and this Fraction will be known by what is taught in *Probl.* 11.

PROBLEM III.

To find the Square Root of a given number less than 10000.

IF you take the half of the Logarithm of the propos'd number, you will have the Logarithm of the Root requir'd, *by Prop.* 6. *Chap.* 4. As for instance to find the square Root of this number 9216, whose Logarithm is 3.9645425, the half of this Logarithm is 1.982272, to which then answers in the second Table, 96, for the square Root of the propos'd number 9216.

PROBLEM IV.

To find the Cube Root of a given number less than 10000.

IF you take the third of the Logarithm of the propos'd number, you will have the Logarithm of the Root requir'd, *by Prop.* 6. *Chap.* 4. Thus to find the Cube Root of this number 9261, whose Logarithm is 3.9666579; the third

third of this Logarithm is 1.3222193, to which there answers in the last Table, 21 for the Cube Root of the propos'd number 9261.

PROBLEM. V.

To find the Logarithm of a Whole number greater than 10000.

YOU must find the Logarithm of a number less than 10000 in the last Table, by the means of which you may find the Logarithm of a number greater than 10000, by a method which tho' not Geometrically true, yet has no sensible defect in the operations by numbers under 100 00000: Wherefore we shall make use of it here.

To find then the Logarithm of a number greater than 10000, and less than 10000000, as the Logarithms of 356 7894; because this number exceeds the greatest of those whose Logarithms are taken notice of in the last Table, and cannot be found there, nor consequently its Logarithm; you must cut off from this number the three Figures on the right hand 894, so that the remainder 3567 may be found in the Table, and opposite to it its Logarithm 3.5523031. You may cut off more Figures, but as the remainder will be less, and the differences of the Logarithms are at the beginning of the Table more unequal among themselves, it may cause some error.

That the error may be less considerable, cut off from the given number the fewest Figures possible on the right hand, so that the remainder may be found as near as possible to the end of the second Table, where the differences of the Logarithms encrease more slowly, that is, where the Logarithms come nigher a simple Arithmetical Progression, such as this method supposes which then will give a more exact Logarithm.

By taking then the Logarithm 3.5523031 of 3567, which ought to be 3567000, being 1000 times greater than 3567, because 'tis as if from the propos'd number 3567894 you had substracted 894, when you have cut off the three Figures 894; therefore add to this Logarithm 3.5523031 the Logarithm of 1000, which is 3.0000000, 'tis readily done only by encreasing the Characteristic 3, of the Logarithm 3 52230 31 by 3, because of the three Figures cut off 894, for Multiplication is perform'd by Addition of the Logarithm of the multiplying numbers, as is seen in *Probl.* I. and you will have 6.5523031, for the Logarithm of 3567000, which Logarithm is less than that of the propos'd number 3567894; to know

know by how much this Logarithm is leſs, ſubſtract the Logarithm 3.5523031 of 3567 from the Logarithm 3.5524248 of the number immediately following 3568, the remainder will be 1217 for the difference of the Logarithm of the numbers 3567, 3568, which is alſo the difference of the Logarithms of the numbers 3567000, 3568000, whoſe difference is 1000, which anſwers to the difference 1217 of their Logarithms. Then ſay by the direct Rule of Three, if 1000, which is the exceſs of 3568000 above 3567000, gives 1217 for the difference of their Logarithms, how much will 894 give, which is the exceſs of the propos'd number 3567894 above 3567000? and you will find 1087 for the difference of their Logarithms, which conſequently being added to the Logarithm 6.5523031 of the leaſt 3567000, you will have 6.5524118 for the Logarithm of the greateſt, or of the given number 3567894.

PROBLEM VI.

To find the Logarithm of a given right Sine of an Arc.

IT is evident by the preceding Problem, that if the given right Sine of an Arc is to a Radius of 10000000 Parts, you may find the Logarithm of this Sine, as was juſt now taught. But if this given Sine is to a Radius of 10000000000 Parts, to which the Logarithms of the Sines, Tangents, and Secants were compos'd in the firſt Table, altho' theſe Sines, Tangents, and Secants were calculated there only to a Radius of 10000000 parts; in this caſe the propos'd Sine may be greater than 10000000, and the Method of the preceding Problem can be no longer of Uſe, becauſe the difference of the Logarithms will be too unequal to be able to give juſtly the Logarithm of ſo great a number. Then it is abſolutely neceſſary to make uſe of a larger Table of Logarithms than the ſecond, where there is at leaſt the Logarithms of the numbers to 100000, ſuch as that in *Brigg's Logarithmetical Arithmetick*, which we will apply by reaſoning, as in the preceding Problem, to find the Logarithm of a given Sine of an Arc, for example of this Sine 4226182617, which belongs to an Arc of 25 degrees, to a Radius of 10000000000 parts.

Becauſe the propos'd number 4226182617 is not found in the Table of the Logarithms, you muſt cut off towards the right hand the five Figures 82617; ſo that the other 42261 may be found there, and oppoſite to it its Logarithm 4.6259398 whoſe Charecteriſtic 4 ſhou'd be augmented by

5, that

5, that is 5.0000000, the Logarithm of 100000, ought to be added to it because of the 5 Figures cut off 82617, leaving the remainder 42261, which ought to be 4226100000, which is 100000 times greater than 42261, and the Logarithm whereof consequently will be 9.6259398, which is less than the Logarithm of the propos'd number 4226182617: and to know by how much it is less, substract the Logarithm 4.6259398 of 42261, from the Logarithm 4.6259500 of the number immediately following 42262, the remainder will be 103 for the difference of the Logarithms of the numbers 42261, 42262, which is also the difference of the Logarithms of the numbers 4226100000, 4226200000, whose difference is 100000, which answers to the difference 103 of their Logarithms. Wherefore you must say by the direct Rule of Three, if 100000 which is the excess of 4226200000 above 4226100000, gives 103 for the difference of their Logarithms, how much will 82617 give, which is the excess of the propos'd number 4229182617 above 422610 000? and you will find 85 for the difference of their Logarithms, which consequently being added to the Logarithm 9.6259398 of the least 4226100000, you will have 9.625 9483 for the Logarithm of the greatest 4226182617, or of the given Sine of an Arc or Angle of 25 degrees.

SCHOLIUM.

You may make use of the second Table without extending it, for by *Probl.* 5. you may find the Logarithms of the two numbers 42261, 42262, and consequently of the two Numbers 4226100000, 4266200000, by augmenting the Characteristics of each by 5, because these two numbers are Multiples of the two preceding ones by this number 100 000, whose Logarithm is 5.0000000; then let the rest be done as was shewn in this Problem, or in the preceding one.

PROBLEM VII.

To find the Logarithms of Tangents and Secants.

THE Logarithms of Tangents and Secants may be computed in the same manner as the Logarithms of Sines: But it may be done more easily and exactly by means of the Logarithms of Sines, thus.

Because *by Prop.* 1. *Chap.* 2. the Tangent of an Arc is a fourth proportional to the Sine Complement, Right Sine, and Radius, it follows *by Prop.* 2. *Chap.* 4. that if to the Logarithm of the Sine of the propos'd Arc you add the Logarithm

rithm of the Radius, and from the Sum ſubſtract the Logarithm of the Sine Complement, you will have the Logarithm of the Tangent of that Arc.

As if an Arc of 25 degrees be propos'd, whoſe Logarithm Sine is 9.625483, and the Logarithm of the Sine Complement is 9.9572757, which if ſubducted from the Sum 19.6259483, of the Logarithm 9.6259483 of the Sine of 25 degrees, and the Logarithm 10.0000000 of the Radius, the Remainder 9.6686726 will be the Logarithm of the gent of the propos'd Arc of 25 degrees, whoſe Tangent Complement will be found by ſubſtracting the Logarithm of the Tangent, now found, from double the Logarithm of the Radius, for *by Prob.* 2. *Chap.* 2. the Radius is a Mean proportional between theſe two Tangents, ſo that *by Prop.* 3. *Chap.* 4. the Sum of the Logarithms of theſe two Tangents is double the Logarithm of the Radius.

Likewiſe becauſe *by Prop.* 2. *Chap.* 3. the Radius is a Mean proportional between the Secant of an Arc, and the Sine Complement, it follows *by Prop.* 3. that if from double the Logarithm of the Radius you ſubſtract the Logarithm of the Sine Complement of the propos'd Arc, you will have the Logarithm of the Secant of that Arc.

As if there was propos'd the ſame Arc of 25 degrees, the Logarithm of whoſe Sine Complement is 9.9572757; if you ſubſtract this Logarithm from the double 20.0000000 of the Logarithm of the Radius, there will remain 10.0427243 for the Logarithm of the Secant of 25 degrees.

PROBLEM VIII.

To find the Logarithm of the Verſed Sine of a given Arc.

IF the given Arc be leſs than a Quadrant, by ſubſtracting its Sine Complement from the Radius, you will have its Verſed Sine, *by Def.* 17. and if the propos'd Arc be greater than a Quadrant, by adding the Radius to the Sine Complement, you will have the Verſed Sine, which being thus found, its Logarithm may be found *by Probl.* 5. But that may be done ſooner and more eaſily thus.

Since *by Prop.* 16. *Chap.* 1. the Square of the Sine of an Arc is equal to the Product under the Verſed Sine of this Arc and half the Radius, or the Sine of 30 degrees, it follows that if you divide the Square of the Sine of half an Arc always by the Sine of 30 degrees, you will have the Verſed Sine of the ſame Arc. From whence it follows *by Prop*, 3. *and* 5. *Chap.* 4. that if from double the Logarithm

rithm of the Sine of half the propos'd Arc, you always substract this number 9.6989700, which is the Logarithm Sine of an Arc of 30 degrees, you will have the Logarithm of the Versed Sine of the propos'd Arc.

As if an Arc of 25 degrees be propos'd, its half is 12°. 30'. The Logarithm Sine of this half is 9.3353368, whose double is 18.6706736, from which substracting the Logarithm 9.6989700, the remainder 8.9717036 is the Logarithm of the Versed Sine of the propos'd Arc 25 degrees.

PRROBLEM IX.

To find the Logarithm of a given Fraction.

WE have observ'd in the beginning of this Chapter, that the Logarithm of a Fraction, which is less than an Unit, whose Logarithm is 0, is a Negative number, which *by Prob.* 5. *Chap.* 4. is equal to the difference of the Logarithms of the Numerator and Denominator of the propos'd Fraction. Thus the Logarithm of this Fraction $\frac{3}{4}$ is —0.1249388, and the Logarithm of $\frac{23}{100}$ is —0.3617278. So of the rest.

PROBLEM X.

To find the Logarithm of a Whole number and a Fraction.

TO resolve this Problem, reduce the given Whole number with its Fraction, into an improper Fraction, whose Logarithm being found *by Probl.* 9. will be that requir'd, but it will be Affirmative because the improper Fraction is greater than a Unit. Thus the Logarithm of $5\frac{2}{3}$, or of $\frac{17}{3}$ is 0.7633277, and the Logarithm of $25\frac{3}{4}$, or of $\frac{103}{4}$ is 1.4107772. So of the rest.

PROBLEM XI.

To find the Number that belongs to a given Logarithm.

FIrst, if the given Logarithm is less than the last and greatest Logarithm 4.0000000 in the second Table, which is the Logarithm of 10000 it may be always found in this Table, or at least that which comes nearest it, and opposite to it on the left hand you have the nearest whole number that belongs to it. But to have this number ac-

curatey,

curately, when the given Logarithm is not found exactly in the Table, do thus.

To find, for example, what number this Logarithm 3.9531250 belongs to, which is less than 4.0000000, seek this Logarithm in the second Table, and because tis not found there exactly, take the Logarithm 3.9530828, which is the next less, to which there answers on the left hand this number 8976, so that the propos'd Logarithm 3.9531250 belongs to 8976, and to something more, which can be but a Fraction, and is found thus.

If you wou'd that the Denominator of the Fraction requir'd, shou'd be, for Example 100, so that the Unit or Integer is divided into 100 equal parts, to find the Numerator, substract from the propos'd Logarithm 3.9531250, the next less Logarithm 3.9530828, of 8976, and you have the excess 422 of the propos'd Logarithm above the Logarithm of 8976. Substract also the same less Logarithm 3.9530828 from the Logarithm immediately following 3.9531312 of 8977, and you have the excess 484, which answers to Unity, or to 100 parts, because 'tis the difference of the Logarithms of the numbers 8976, 8977. Wherefore to find in proportion what shou'd give the excess 422 of the propos'd Logarithm above the Logarithm of 8976, say by the direct Rule of Three, if the excess 484 gives 100 parts, how much will the excess 422 give? you will find 87 parts for the Numerator of the Fraction requir'd, which consequently will be $\frac{87}{100}$. So that the propos'd Logarithm 3.9531250 is the Logarithm of $8976\frac{87}{100}$ pretty near.

I said pretty near, because this Method is not Geometrically true, but it will have no sensible defect when the given Logarithm is found between those of 1000 and 10000, where the differences are almost proportionals to those of their numbers. Wherefore when the given Logarithm is less than that of 1000, to find more exactly what number it belongs to, augment the Logarithm by what number you will, provided the Sum may be found between the Logarithms of 1000 and 10000, and having found as was just now taught, to what number this Logarithm belongs, divide this number so found by that whose Logarithm was added to the propos'd one, because Addition of Logarithms is Multiplication of Absolute numbers, *by Prop* 4. *Chap.* 4. and you have the number requir'd, with its Fraction, as exact as possible.

Thus to find what number this Logarithm 1.8243945 belongs to, which is too little, add to it this Logarithm 2.0000000, which belongs to the number 100, and you will have

have this other Logarithm 3.8243945, which belongs to this number $6674\frac{13}{100}$, this being divided by 100, which is the number whose Logarithm was added to the given Logarithm, you will have $66\frac{7413}{10000}$, for the number which belongs to thepropos'd Logarithm 1.8243945.

Secondly if the given Logarithm is greater than the last Logarithm 4.0000000 of the second Table, as is 4.5524118, and you wou'd find to what number this Logarithm belongs, which cannot be found in the last Table, because 'tis too great, diminish it by the Logarithm of the least number you can, so that the remainder may be found in the second Table, as by this Logarithm, 0.6020600, which belongs to the number 4, and there will remain this other Logarithm 3.9503518, which belongs to the number $8919\frac{73}{100}$ this being multiplied by the number 4 whose Logarithm was substracted from the propos'd one, because Substraction of Logarithms is Division in common numbers by *Prop.* 5. *Chap.* 4. you will have $35678\frac{23}{25}$ the number which belongs to the propos'd Logarithm 4.5524118.

PROBLEM XII.

To find the Sine, Tangent, or Secant of a given Arc or Angle in Degrees, Minutes, and Seconds.

TO find, for example, the Sine of an Arc or Angle of 40 degrees, 32 Minutes, and 22 Seconds, you will find in the first Table that the Sine of 40 degrees and 32 minutes is 6498903, to which something ought to be added because of the 22 Seconds over and above: and to find what shou'd be added to it, substract it from the Sine immediately following 6501114, and you have their difference 2211, which answers to a Minute, or 60 Seconds. Wherefore say by the direct Rule of Three, if 60 Seconds give 2211 for the excess of the Sine of 40°. 33′. above the Sine of 40°. 32′, how much will 22 Second give? and you will find 811 for the excess of the Sine of 40°. 32′. 22″, above the Sine of 40°. 32′, if then you add this excess 811 to the Sine 6498903 of 40°. 32′, you will have 6499714 for the Sine of the given Arc 40°. 32′. 22″.

You will find in the same manner the Logarithm Sine of a given Arc or Angle in Degrees, Minutes, and Seconds, as also the Tangents and Secants, either in Absolute numbers, or in Logarithms, tho' not so exact as the Sines, because their differences are more unequal.

PRO-

PROBLEM XIII.

To find the Degrees, Minutes, and Seconds that belong to a given Sine, Tangent or Secant.

TO find what Angle, or Arc belongs, for example, to this Sine 6297824; ſeek this Sine in the firſt Table, and ſince 'tis not found exactly there, take the next leſs 6297 724, which anſwers to an Arc of 39°. 2′. So that the given Sine 6297824 belongs to an Arc or Angle of 39°. 2′. and ſome Seconds more, which may be found thus.

Subſtract this leſs Sine 6297724 from its following 629 9983, which belongs to an Arc of 39°. 3′. and you have their difference 2259, which anſwers to a Minute or 60 Seconds, ſubſtract it alſo from the propos'd Sine 6297824, and you have their difference 100, and ſay by the Direct Rule of Three, if the exceſs 2259 of the Sine of 39°. 3′, above the Sine of 39°. 2′. give 60 Seconds, how much will the exceſs 100, of the propos'd Sine give above the ſame Sine of 39°. 2′? and you will find 2 Seconds for the overplus requir'd; ſo that the given Sine 6297824 belongs to Arc of 39. 2′. 2″.

You will find in the ſame manner the Degrees, Minutes and Seconds belonging to a Logarithm Sine; and it is eaſie to conceive that this Method may be alſo applied to Tangents and Secants, tho' there the Seconds cannot be had ſo exactly, becauſe their differences are more unequal.

PROBLEM XIV.

To find the Logarithm of the difference of two given Square Numbers.

BEcauſe the difference of two ſquare numbers is equal to the Product under the Sum and the difference of their ſides, *by* 5.2, it follows *by Prop.* 4. *Chap.* 4. that if you add the Logarithms of this Sum and difference, you will have the Logarithm of the difference of the two given Squares.

Thus if theſe two ſquare numbers 65536, 20736, be propos'd, whoſe Sides are 256144, their Sum is 400, and difference 112, whoſe Logarithms are 2.6020600, 2.0492180; the Sum 4.6512780 of theſe two Logarithms will be the Logarithm of the difference 44800 of the two given Squares.

Book II.

OF

RECTILINEAL Trigonometry.

RECtilineal *Trigonometry* teaches the manner of computing the parts of a Rectilineal Triangle, by means of the two following Tables, as you will see after we have explain'd and demonstrated in the following Chapter some Theorems serveing for the Demonstration of the Practices we shall teach in the second Chapter, where we treat of Right-angled Triangles, and in the third Chapter of Oblique angled Triangles.

CHAP. I.

Of THEOREMS.

TO render the practice of Rectilineal Trigonometry more easy, we have thought fit to separate the Theory from the Practice, by making a particular Chapter of Theorems which are necessary for the Demonstration of the Practice, which we shall find without Trouble in the two other Chapters.

THEOREM I.

In a right-angled Triangle, the Ratio of one Side to the other, is equal to that of the Radius, to the Tangent of the Angle opposite to this other Side.

Plate 2. Fig. 22. I Say that if the Triangle ABC is right-angled in A, the Side AB, for example, is to the Side AC, as the Radius is to the Tangent of the Angle B, opposite to the side AC.

DEMONSTRATION.

If from the Angle B as Centre, you describe with any extent BD for Radius, the Arc DE, which will be the measure of the Angle B, and that from the point D, you draw the right line DF perpendicular to the Radius BD, this perpendicular DF will be the Tangent of the Angle B, or of the Arc DE which measures it, and the right-angled Triangle BDF will be equiangled to the right-angled Triangle BAC, *by* 32. 1. Wherefore *by* 4. 6. the Side AB will be to the Side AC, as the Radius BD to the Tangent DF. *Which was to be demonstrated.*

SCHOLIUM.

It will appear in the same manner, that the Side AC is to the Side AB, as the Radius is to the Tangent of the Angle opposite to the Side AB, namely by describing from this Angle C an Arc of a Circle, as was done from the Angle B.

COROLLARY.

It follows from this Proposition that if in the right-angled Triangle ABC, each of the two sides AB, AC be given, either of the two acute Angles C, B may be found; and if in the same right-angled Triangle ABC, besides the angles, one side, as AB, be given, the other side AC may be found.

THEOREM II.

In a right-angled Triangle, the Ratio of one of the Legs to the Hypotenuse, is equal to that of the Radius, to the Secant of the Angle adjacent to this Leg.

WE call that an *Angle adjacent to a Side*, in any Triangle whatsoever, which is form'd by this and another side.

ſide. This being ſuppos'd, I ſay that if the Triangle ABC is right angled in A, the ſide AB is to the Hypotenuſe BC, as the Radius is to the ſecant of the angle B, adjacent to the ſide AB. Plate 2. Fig. 22.

DEMONSTRATION.

By making a conſtruction like the preceding, it will appear that the line BF is the Secant of the Angle B, or of the Arc DE, which meaſures it, with reſpect to the Radius BD; and in the two ſimilar right-angled Triangles ABC, DBF, the ſide AB is to the Hypotenuſe BC, as the Radius BD to the Secant BF. *Which was to be demonſtrated.*

SCHOLIUM.

It will appear in the ſame manner that the ſide AC is to the ſame Hypotenuſe BC, as the Radius to the Secant of the Angle C, adjacent to the ſide AC, namely by deſcribing an Arc from the angular point C, as was done from the angular point B.

COROLLARY.

It follows from this Theorem, that if in the right angled Triangle ABC, the Hypotenuſe BC, and one of the two ſides AB, AC, be known, each of the two acute Angles B, C, may be found; and that if in the right angled Triangle ABC, beſides the Angles, the Hypotenuſe BC be given, either of the two ſides AB, AC may be found; or if beſides the angles one of the two ſides AB, AC, be known, the Hypotenuſe BC may be found.

THEOREM III.

In a right angled Triangle, the Hypotenuſe is to one of the two Legs, as the Radius is to the Sine of the Angle oppoſite to that Leg.

I Say, that if the Triangle ABC be right angled in A, the Hypotenuſe BC is to the Leg AC, as the Radius is to the Sine of the Angle B, oppoſite to this Leg AC. Fig. 22.

DEMONSTRATION.

Plate 2. Fig. 22. If from the angular point B, as Centre, with any distance BD, the Arc DE be describ'd, and if from the point E the right line EG be drawn, perpendicular to the Radius BD, this perperpendicular EG will be the Sine of the Angle B, or of the Arc DE which measures it, and the right angled Triangle ABC will be equiangular with the right angled Triangle GBE *by* 32. 1. because of the common Angle B; Wherefore *by* 4. 6. the Hypotenuse BC will be to the Leg AC, as the Radius BE is to the Sine EG. *Which was to be demonstrated.*

SCHOLIUM.

It will appear in the same manner, that the same Hypotenuse BC is to the side AB as the Radius is to the Sine of the Angle C opposite to the side AB, namely by describing an Arc from the angular point C, as was done from the angular point B. From whence we may easily conclude, that the Radius being the Sine of the right angle A, which is opposite to the Hypotenuse BC, *the three Lines or Sides of a right angled Triangle, are proportional to the Sines of their opposite Angles.* This is also true in an Oblique angled Triangle, as will be shewn in the following Theorem.

COROLLARY.

It follows from this Theorem, that if in a right angled Triangle the Angles and a Leg be known, the other Leg and the Hypotenuse may be found; or if the Angles and the Hypotenuse be known, either of the two other Legs may be found; or again, if the Hypotenuse and one Leg be known, each of the two acute angles may be found.

THEOREM IV.

In every right lined Triangle, the Sines of the Angles are proportional to their opposite Sides.

Fig. 23. I Say, that in the right lined Triangle ABC, whether right angled or oblique angled, the Sine of the angle A is to its opposite side BC, as the Sine of the angle B is to its opposite side AC.

DEMONSTRATION.

If from the angle C the line CD be drawn, perpendicular to the opposite side AB, which is call'd *Basis* with respect to this perpendicular, it will appear *by the preceding Theorem*, that in the right angled Triangle ADC, the Sine of the angle A is to its opposite side CD, as the Sine of the right angle D, or the Radius, is to the Hypotenuse AC; and that in the right angled Triangle CDB, the side CD is to the Sine of its opposite angle B, as the Hypotenuse BC is to the Radius : From whence it follows, *ex æquo perturbata*, that the Sine of the angle A is to the Sine of the angle B, as the side BC is to the side AC ; and *by alternation*, the Sine of the angle A is to the side BC, as the Sine of the angle B is to the side AC. *Which was to be demonstrated.* Plate 2. Fig. 23.

SCHOLIUM.

It will appear in the same manner, that the Sine of the angle A is to its opposite side BC, as the Sine of the angle C is to its opposite side AB; and that the Sine of the angle B is to its opposite side AC as the Sine of the angle C is to its opposite side AB, namely by letting fall from one of the two other angles A, B, a perpendicular on its opposite side, without minding whether this perpendicular falls within or without the Triangle, because the Demonstration will be always the same.

COROLLARY.

It follows from this Theorem, that if in the Triangle ABC, besides the Angles, a side be known, as AB, either of the two other sides AC, BC, may be found; and if two sides, as AB, BC, and one of their opposite Angles A, C, as A, be known, the other angle C may be found, tho' you'll meet with an ambiguity, because this angle C may be acute and obtuse, as you'll see in the following Theorem.

THEOREM V.

Two Triangles may be different, tho' there be two Sides in each respectively equal, and an Angle opposite to one and the same Side equal.

Plate 2. Fig. 24. FRom the extremity A of the line AB, thro' any point C in that line, describe the arc CDEF, and draw from the other extremity B the right line BE, cutting the Circumference CDEF, in two points as D, E, thro' which to the Centre A, draw the two equal lines AD, AE, and you have two different Triangles ADB, AEB, where the side AD is equal to the side AE, and the side AB, common, as also the angle B common, which is opposite to the two equal sides AD, AE. *Which was to be demonstrated.*

SCHOLIUM.

It is evident, because of the Isosceles Triangle DAE, that the angle E of the Triangle AEB is acute, and that the angle D of the Triangle ADB is obtuse; so that when the two sides AB, AE, or AD, and the angle B opposite to the given side AE, or AD, are given, to find the other angle E, or D, opposite to the other given side AB, you shou'd know the species of this angle, since it may be acute or obtuse, the same given things remaining. There is only this ambiguity in Right lined Triangles, but there will happen many others in Spherical Triangles, as you will see in the third Book.

THEOREM VI.

The sum of the two unequal sides of a Triangle that is not equilateral, is to their difference, as the Tangent of half the sum of the two Angles opposite to these two unequal sides, is to the Tangent of half the difference of the same Angles.

Plate 3. Fig. 27. I Say, that of the two unequal sides AC, BC, of the Triangle ABC, their sum is to their difference, as the Tangent of half the sum of the angles A, B, opposite to these two sides, is to the Tangent of half the difference of the same angles A, B.

PREPARATION.

From the angle C, included by the two ſides AC, BC, now concern'd, thro' one of the other angular points, as ſuppoſe B, deſcribe the Circumference of a Circle EBDH. Produce one of the two ſides AC, BC, as AC, both ways, meeting the Circumference of the Circle in the points D, E, and join the right lines BD, BE, which will be perpendicular to each other *by* 31. 3. and then it will eaſily appear that AD is the ſum of the ſides AC, BC, becauſe of the two equal lines BC, CD, and that AE is the differerce of the ſame ſides AC, BC, becauſe of the two equal lines BC, CE. Draw again from the point E the right line EF parallel to the right line BD, and conſequently perpendicular to the line BE *by* 29. 1. which line EF meets the third ſide AB produc'd in F. Deſcribe again from the point E thro' the point B, the arc BG, which *by* 16 3. is touch'd in B by the right line BD, which conſequently will be the Tangent of this arc BG, or of the angle BED, which it meaſures, with reſpect to the Radius EB: and from the point B thro' the point E, deſcribe the arc EI, which *by* 16. 3. will be touch'd in E by the right line EF, which conſequently will be the Tangent of the arc EI, or of the the angle ABE, which it meaſures; and then *by* 32. 1. the angle BCD is the ſum of the two angles A, B, and *by* 20. 3. the angle BED is half this ſum, from whence it follows that the line BD is the Tangent of half the ſum of the angles A, B, with reſpect to the Radius EB. Alſo *by* 32. 1. the angle A exceeds the angle BED by the little angle ABE, and the angle B is exceeded by the ſame angle BED, or EBC its equal *by* 5. 1. by the ſame little angle ABE, and conſequently this little angle ABE is half the difference of the two angles A, B, and ſo the Tangent of half their difference is EF. I ſay then that the ſum of the ſides AD is to their difference AE, as the Tangent BD of half the ſum of the angles, is to the Tangent EF of half their difference. Plate 3. Fig. 27.

DEMONSRATION.

Since the two lines BD, EF, are parallel, *by Conſtr.* the two alternate angles BDE, DEF, will be equal *by* 29. 1. and ſince the two vertical and oppoſite angles BAD, EAF, are alſo equal to each other *by* 15. 1. it follows *by* 32. 1. that the two Triangles ABD, AEF, are equiangular, and *by* 4. 6. the four lines AD, AE, BD, EF, are proportionals. *Which was to be demonſtrated.*

COROLLARY.

Plate 3. Fig. 27. It follows from this Propoſition, that if in the Triangle ABC, the two ſides AC, BC, are known, and the compris'd angle C, each of the two other angles A, B, may be found; for half their ſum BED may be known, and conſequently half their difference ABE, which being added to half the ſum BED, you will have the greateſt angle A, and being ſubſtracted from the ſame half BED, or EBC, there will remain the leaſt angle B.

THEOREM VII.

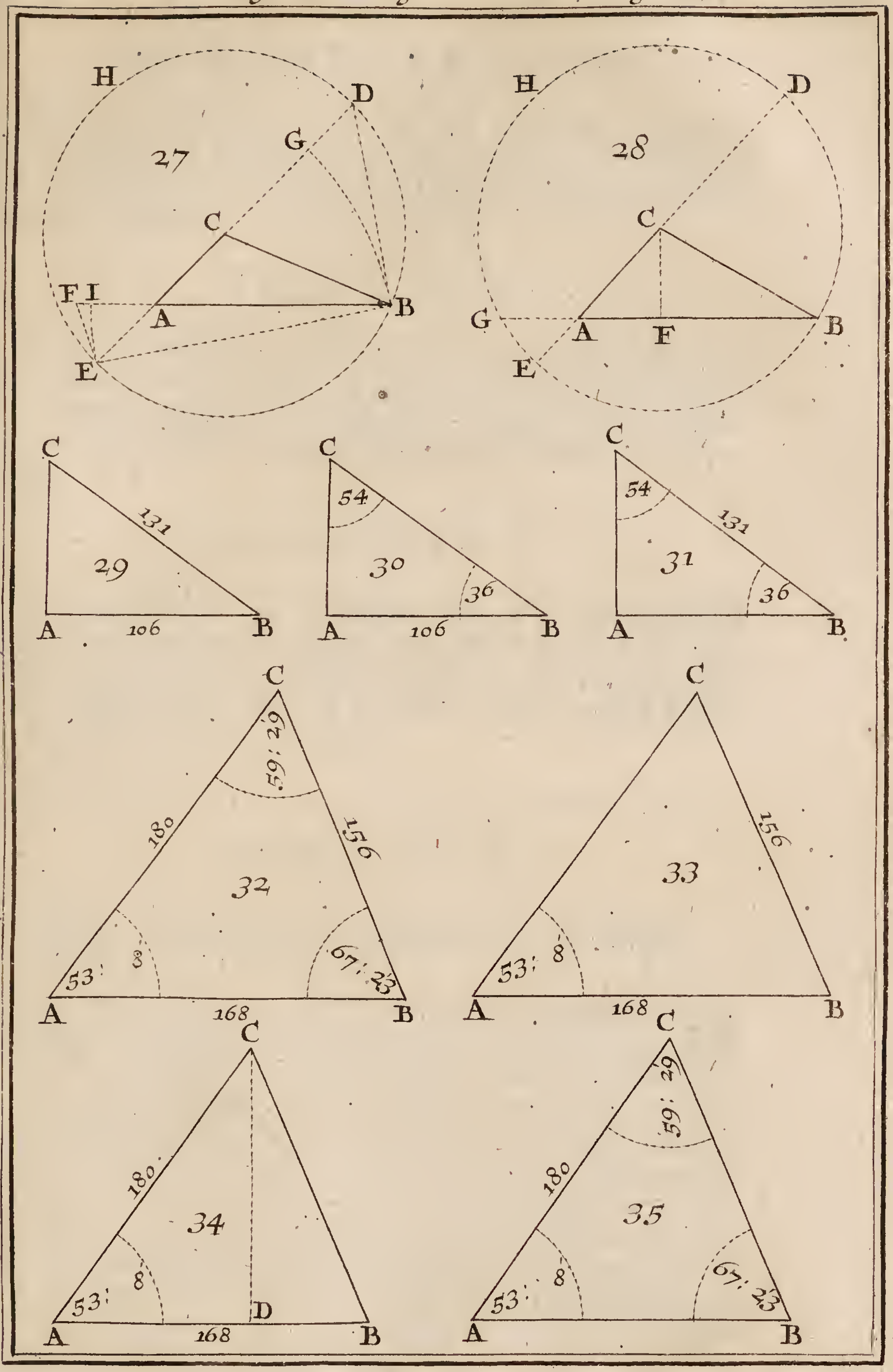
If in a Triangle that is not equilateral, from the greateſt Angle a Perpendicular be let fall on the Baſe, dividing it into two unequal Segments, this Baſe will have the ſame Ratio to the ſum of the two other Sides, as their difference has to the difference of the Segments.

Fig. 28. I Say, that if from the greateſt angle C of the Triangle ABC, whoſe two ſides AC, BC are unequal, the perpendicular CF be let fall on the baſe AB, dividing it into two unequal ſegments AF, BF; the baſe AB has the ſame Ratio to the ſum of the two other ſides AC, BC, as their difference has to the difference of the ſegments AF, BF.

PREPARATION.

From the angle C, with one of the two ſides AC, BC, as ſuppoſe the greateſt BC, deſcribe the Circumference of a Circle BEGHD, and produce the other ſide AC, and the baſe AB, to meet the Circumference of the Circle in the points D, E, G, and AD is the ſum of the ſides AC, BC, becauſe of the equal lines BC, CD; AE the difference of the ſame ſides AC, BC, becauſe of the equal lines BC, CE; and AG the difference of the ſegments AF, BF, becauſe of the equal lines FG, FB, *by* 3. 3. I ſay then, that the baſe AB is to the ſum of the ſides AD, as their difference AE is to the difference AG of the ſegments.

DE-


27
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36
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32
C
59 : 29
180
156
53 : 8
67 : 23
A
168
B
33
C
156
53 : 8
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B
34
C
180
53 : 8
D
A
168
B
35
C
59 : 29
180
53 : 8
67 : 23
A
B

DEMONSTRATION.

Since the Rectangle under the lines AB, AG, is equal to the Rectangle of the lines AD, AE, *by* 35. 3. it follows *by* 14. 6. that the four lines AB, AD, AE, AG, are proportionals. *Which was to be demonstrated.*

SCHOLIUM.

It is not absolutely necessary that the perpendicular CF should fall from the greatest Angle, this being here suppos'd, only that it might fall within the Triangle, because otherwise it might fall without, which wou'd alter the Theorem.

COROLLARY.

It follows from this Theorem, that if in the Triangle ABC, the three sides be known, the Segments AF, BF may be known, because their difference AG may be found, which being added to the Base AB, will give BG, whose half is the greatest Segment, BF, *&c.*

CHAP. II.

Of the Calculation of Right-angled Triangles.

WE begin the Practice with Rightangled Triangles, whose Theory, as also the Computation is more easy since here the Radius is always concern'd, which facilitates the Multiplication and Division, when it is to be done by the Radius, which we will suppose only of 100000 parts; In all our Examples we shall make use of the same right-angled Triangle, as ABC, whose sides are of as many Feet, and the Angles of as many degrees as are signified in the Figure, and according to the different Cases in each Problem, we seek for the Angles and Sides of the same Triangle, as if we knew them not, which will serve for proof, when they are found such as they shou'd be.

PROB.

PROBLEM I.

The two Legs of a right-angled Triangle being given, to find the Acute Angles.

Plate 2. Fig. 25.

IF the Side AB of the Triangle ABC right-angled in A, is 106 Feet, and the other side AC, 77, and you wou'd find the Acute angle B, adjacent to the given Side AB; make *by Theor.* 1. this Analogy,

As the adjacent Side AB	106
To the opposite Side AC	77
So is the Radius	100000
To a fourth number	72641

which being the Tangent of the Angle B, seek for it in the Column of Tangents, and taking the nearest, you will find precisely 36 degrees, for the Angle B requir'd; whose Complement is found opposite to it in the other page, namely 54 degrees for the value of the other Acute Angle C, adjacent to the given side AC, which may be also found by this Analogy,

As the adjacent Side AC	77
To the opposite Side AB	106
So is the Radius	100000
To the Tangent of the Angle C.	137661

to which there answers in the first Table about 54 degrees for the angle C, whose Complement 36 degrees, is found opposite to it in the other page, for the other angle B. Thus 'tis indifferent which of the two acute Angles B, C, you find, because one being given, the other which is its Complement *by* 32. 1. is also given; but for practice, it is better to find the least angle, because its Tangent is not so great, and so the Division necessary in the operation is sooner done; but to avoid this Division, use the Logarithms thus.

Since the preceding analogy we work'd by common numbers, be multiplying the second term 106 by the third 100000, and dividing the Product 10600000 by the first 77, to have the fourth proportional 137661; but to work by Logarithms, add together the Logarithms of the second and third, and substract from their Sum the Logarithm of the first, and the remainder will be the Logarithm of the fourth, which remainder being lookt for among the Logarithm Tangents, its

Plate 2. Fig. 26.

Vulgar Numbers.		*Logarithms.*	
AC	77	1.8864907	
AB	106	2.0253059	
Radius	10000000000	10.0000000	
		12.0253059	*Sum.*
Log. Tang. 54°. = *LC.*		10.1388152	*Remainder.*

its nigheſt, will give, as before, 54 Degrees for the quantity of the angle C.

We ſhall give no more examples in Logarithms in this Chapter, becauſe in the Computation of Right angled Triangles, 'tis as ſoon done by vulgar numbers, becauſe of the Radius, which being always concern'd in the Calculation, very much ſhortens the Operations. But the Logarithms are of great uſe in Oblique angled Triangles, eſpecially in Spherical Trigonometry.

PROBLEM II.

The Hypotenuſe and a Leg being given, to find the Acute Angles.

If the ſide AB of the Triangle ABC, right angled in A, is 106 Feet, and the Hypotenuſe BC 131, you may find the angle B adjacent to the given ſide AB, by making *by Theor.* 2. this analogy. Plate 3. Fig. 29.

As the Side AB	106
To the Hypotenuſe BC	131
So is the Radius	100000
To a fourth Number	123585

which being the Secant of the angle B, and lookt for among the Secants, you will find the nigheſt to anſwer 35°, 59′. for the angle B, whoſe Complement 54°. 1′. is found oppoſite to it in the other page, for the other angle C, which may be alſo found by making *by Theor.* 3. this other analogy,

As the Hypotenuſe BC	131
To the Side AB	106
So is the Radius	100000
To a fourth Number	80915

which

which being the Sine of the angle C, and lookt for among the Sines, where over against its nighest you find 54°. 1'. for the angle C, and opposite to it in the other Page, its Complement 35°. 59'. for the other angle B.

PROBLEM III.

The Angles and a Leg being given, to find the other Leg.

Plate 3. Fig. 30. IF the angle B of the Triangle ABC, right angled in A, is for example 36 degrees, and consequently its complement C 54 degrees, and the side AB 106 feet, you may find the other side AC, by making *by Theor.* 1. this analogy:

As the Radius	100000
To the Tangent of B adjacent to the given Side AB	72654
So is the Side AB	106
To the Side AC	77

which will be 77 feet, and may be found otherwise thus, *by Theor.* 2.

As the Sine of the Angle C, opposite to the given Side AB	80902
To the Side AB	106
So is the Sine of the Angle B	58778
To the Side AC	77

PROBLEM IV.

The Angles and a Leg being given, to find the Hypotenuse.

IF the angle B of the Triangle ABC, right angled in A, is for example 36 degrees, and consequently its Complement C 54 degrees, and the side AB 106 feet, you may find the other side AC, by making *by Theor.* 2. this analogy:

As the Radius	100000
To the Secant of the Angle B adjacent to the given Side AB	123606
So is the Side AB	106
To the Hypotenuse BC	131

which

which will be 131 feet, and may be found otherwise thus, *by Theor.* 3. Plate 3. Fig. 30.

As the Sine of the Angle C, opposite to the given Side AB	80902
To the Radius	100000
So is the Side AB	106
To the Hypotenuse BC	131

PROBLEM V.

The Angles and Hypotenuse being given, to find either of the two Legs.

IF the angle B of the Triangle ABC, right angled in A, is for example 36 degrees, and consequently its Complement C 54 degrees, and the Hypotenuse BC 131 feet, you may find one of the two sides AB, AC, as AB, by making *by Theor.* 3. this Analogy: Fig. 31.

As the Radius	100000
To the Hypotenuse BC	131
So is the Sine of the Angle C, opposite to the Side AB requir'd	80902
To the Side AB	106

which will be 106 feet, and may be otherwise found thus, *by Theor.* 2.

As the Secant of the Angle B, adjacent to the Side AB requir'd	123607
To the Radius	100000
So is the Hypotenuse BC	131
To the Side AB	106

PROBLEM VI.

The Hypotenuse and a Leg being given, to find the other Leg.

IF the side AB of the Triangle ABC, right angled in A, is 106 feet, and the Hypotenuse BC 131, you may find the other side AC, by getting first the angles B, C, *by Probl.* 2. and afterwards the side AC, *by Probl.* 3. or *by Probl.* 5. But this side may be found more easily, thus: Fig. 29.

Multi-

Plate 3. Fig. 29. Multiply the length 131 of the Hypotenuse BC by its self, and you have its square 17161. Multiply also the length 106 of the given side AB by its self, and you have its square 11236, which being substracted from the preceding square 17161, the remainder 5925 will be the square of the side AC, *by* 47. 1., wherefore if you extract the square Root of this remainder 5925, or its nighest, you will have 77 feet for the length of the side AC requir'd.

Or again, because *by* 5. 2. the product under the sum and difference of any two numbers is equal to the difference of the squares of the same two numbers, if you multiply the sum 237 of the Hypotenuse BC and of the given side AB, by their difference 25, the product 5925 will give, as before, the square of the other side AC requir'd, *&c.*

PROBLEM VII.

The two Legs being given, to find the Hypotenuse.

Plate 2. Fig. 26. IF the side AB of the Triangle ABC, right angled in A, is 106 feet, and the other side AC 77, you may find the Hypotenuse BC, by getting first *by Probl.* 1. the acute angles B, C, and then the Hypotenuse BC, *by Probl.* 4. or more easily thus:

Multiply the length 106 of the side AB by its self, and you have its square 11236. Multiply also the length 77 of the other side AC by its self, and you have its square 5929, which being added to the preceding square 11236, the sum 17165 will be the square of the Hypotenuse BC, *by* 47. 1. wherefore by extracting the square Root of this 17165, or its nighest, you will have 131 feet for the length of the Hypotenuse BC requir'd.

Or again, since *by* 4. 2. the square 33489 of the sum 183 of the two sides AB, AC, is equal to the double product 16324, and to the sum of their squares, or *by* 47. 1. to the square of the Hypotenuse BC, if from this square 33489 you substract the double product 16324, the remainder 17165 will give as before, the square of the Hypotenuse BC, *&c.*

CHAP.

CHAP. III.

Of the Calculation of Oblique-angled Triangles.

WE ſhall make uſe alſo in the following Problems, of one and the ſame Oblique angled Triangle, as the Triangle ABC, whoſe ſides are as many feet, and the angles as many degrees and minutes as is ſignified in the figure, that thereby one may ſee the proof of each operation, when the angles and ſides are found ſuch as they ſhou'd be. Plate 3. Fig. 32.

PROBLEM I.

Two Sides and the Angle oppoſite to one of them being given, to find the other angles.

IF the ſide AB of the oblique angled Triangle ABC is 168 feet, and the ſide BC 156, and if the angle A, oppoſite to the given ſide BC, is 53°. 8′, you may find the other angles B, C, as firſt the angle C, oppoſite to the other given ſide AB, by making *by Theor.* 4. this analogy: Fig. 33.

As the Side BC	156
To the Sine of the oppoſite Angle A	80003
So is the Side AB	168
To the Sine of the oppoſite Angle C	86157

to which there anſwers in the Tables about 59°. 29′. for the angle C, when it is acute, for it may be obtuſe *by Theor.* 5. then ſubſtract 59°. 29′. from 180 degrees, and the remainder will be the angle C, which being added to the given angle A, ſubſtracting the ſum from 180 degrees, the remainder will be the third angle B, *by* 32. 1.

PRO-

PROBLEM II.

Two Sides and the Angle which they comprehend being given, to find the other Angles.

Plate 3. Fig. 34. IF the ſide AB of the Oblique angled Triangle ABC is 168 feet, and the ſide AC 180, and if the compris'd angle A is 53°. 8′. you may find each of the two other angles B, C, thus,

Add together the two ſides AB, AC, and you have their ſum 348, and ſubſtract the leaſt AB from the greateſt AC, and you have their difference 12; laſtly ſubſtract the given angle A from 180 degrees, and the remainder 126°. 52′. will be the ſum of the two angles B, C, requir'd, *by* 32. 1. then make *by Theor.* 6. this Analogy:

As the Sum of the Sides AB, AC,	348
To their difference	12
So is the Tangent of half the Sum of the Angles B, C,	199986
To the Tangent of half their difference	6896

to which Tangent there anſwers in the firſt Table about 3°. 57′. for half the difference of the two angles B, C which being added to half their ſum, which is 63°. 26′. you will have 67°. 23′. for the greateſt angle B, and being ſubſtracted from the ſame half, there will remain 59°. 29′. for the leaſt angle C.

SCHOLIUM.

You may find the two angles B, C, otherwiſe, without uſing *Theor.* 6 but the Calculation will be longer, and alſo not ſo exact, and is this.

Let fall from one of the two unknown angles B, C, as from the angle C, to its oppoſite ſide AB, the perpendicular CD, which falls here within the Triangle, and then the angle ACD of the Triangle ADC, right angled in D, will be 36°. 52′. namely, the Complement of the given angle A: and as the Hypotenuſe AC of the ſame right angled Triangle ADC is alſo known, you may find the perpendicular CD, and the ſegment AD, by making *by Prob.* 5. *Chap.* 2. theſe two Analogies.

As

Plate 3. Fig. 34.

As the Radius	100000
To the Hypotenuse AC	180
So is the Sine of the Angle A	80003
To the Perpendicular CD, in Feet	144

As the Radius	100000
To the Hypotenuse AC	180
So is the Sine of the Angle ACD	59995
To the Segment AD in Feet	108

This 108 Feet being subſtracted from the Baſe AB, there will remain 60 Feet for the other Segment BD, which being alſo known, with the Perpendicular CD, you may find the angle B in the Triangle CDB, right angled in D, by making *by Prob.* 1. *Chap.* 2. this Analogy,

As the Segment BD	60
To the Perpendicular CD	144
So is the Radius	100000
To the Tangent of the Angle B, 67°. 23′.	240000

This Method may be abridg'd by means of the following Canon; *Divide the Product made of the Radius, the Sine of the given Angle A, and the given Side AC oppoſite to the Angle B requir'd, by the difference of the Product made of the other given Side AB and the Radius, and of the Product made of the firſt Side AC, and the Sine Complement of the given Angle A, and you will have the Tangent of the Angle B.*

It is evident *by* 5. 1. and *by* 32. 1. that when the two given ſides AB, AC are equal to each other, each of the two angles B, C, will be half the Remainder of the given angle A, from 180 degrees.

PROBLEM III.

The Angles and a Side being known, to find either of the two other Sides.

If the angle A of the oblique angled Triangle ABC is 53°. 8′. the angle B 67°. 23′. and conſequently the third angle C 59°. 29′. and the ſide AC 180 feet; either of the two other ſides AB, BC, as AB, may be found by making *by Theor.* 4. this Analogy, Fig. 35.

Plate 3. Fig. 35.

As the Sine of the Angle B	92310
To its opposite Side AC	180 feet.
So is the Sine of the Angle C	86148
To its opposite Side AB	168 feet.

PROBLEM IV.

Two Sides, and the Angle included by them, being given, to find the third Side.

Fig. 34. IF the side AB of the oblique angled Triangle ABC is 168 feet, and the side AC 180, and the included angle A 53°. 8′. the third side BC may be found by seeking *by Prob.* 2. one of the two other angles B, C, and *by Prob.* 3. the side BC: Or get *by Prob.* 2. the Perpendicular CD, and the Segment BD, and *by Prob* 7. *Chap.* 2. the side BC.

This second Method may be abridg'd by means of the following Canon; *Divide the double Solid under the two given Sides AB, AC, and the Sine Complement of the included Angle A, by the Radius, and substract the Quotient from the Sum of the Squares of the same Sides AB, AC, the Square Root of the Remainder will be the Side BC requir'd.*

PROBLEM V.

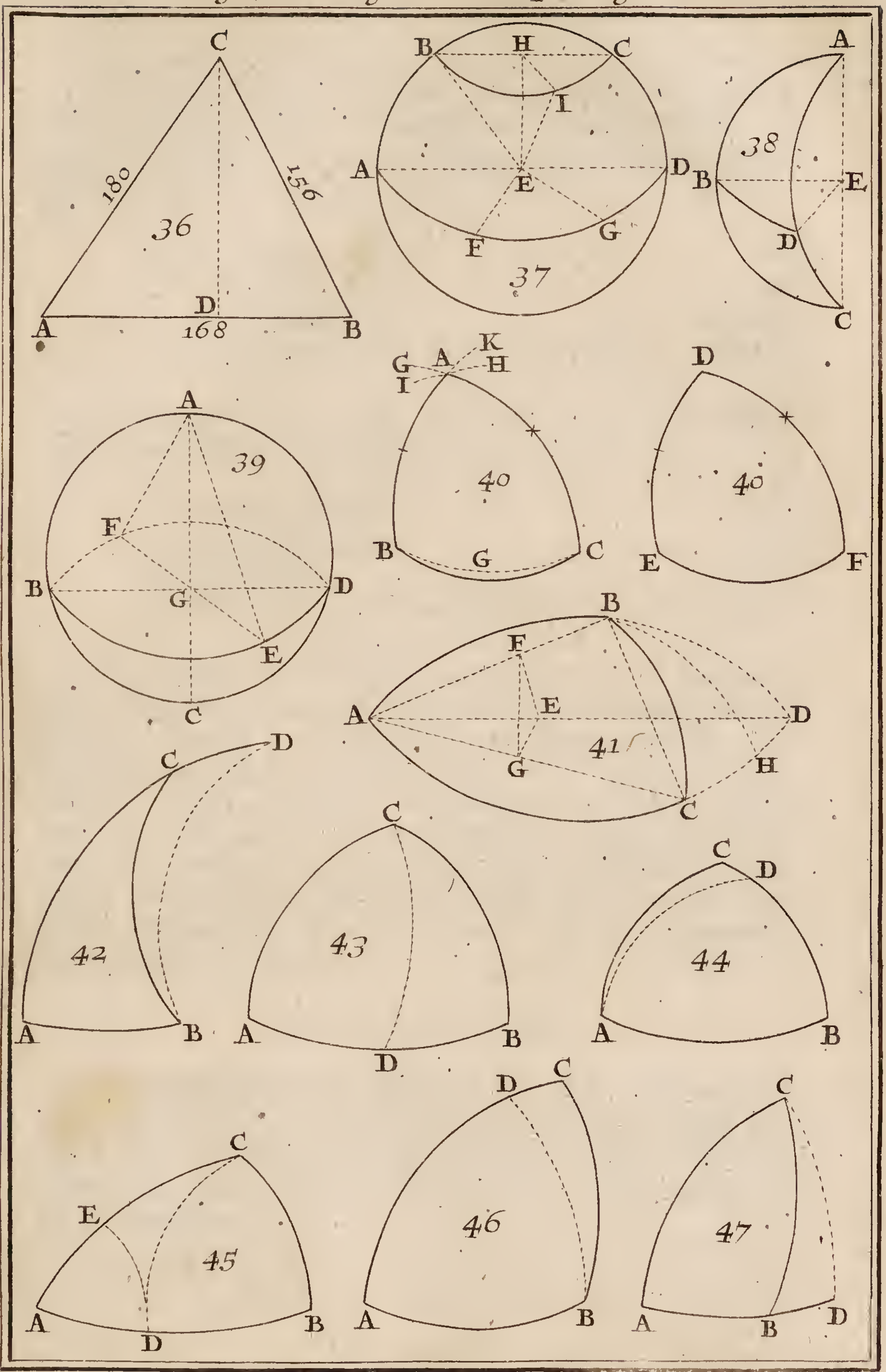
The three Sides being given, to find any of the three Angles.

Plate 4. Fig. 36. IF the side AB is, for example, 168 feet, the side AC 180, and the side BC 156, and you would find the angle A or B; draw from the third angle C, to its opposite side AB, the Perpendicular CD, which shou'd fall within the Triangle, so that you may apply *Theor.* 7. to find the Segments AD, BD, by getting first their difference by this Analogy,

As the Base AB	168
To the Sum of the two other Sides AC, BC,	336
So is the difference of the same Sides AC, BC,	24
To the difference of the Segments AD, BD	48

which will be found 48 feet, and being added to 168 feet of the Base AB, the sum will be 216, whose half 108 feet is the greatest Segment AD, and being substracted from the Base AB, leaves 60 feet for the least Segment BD.

These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180
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These two Segments being thus found, you will have in the two right angled Triangles ADC, BDC, the Hypotenuse and a side given; wherefore to find for example the angle A, make by *Prob.* 2. *Chap.* 2. in the right angled Triangle ADC, this Analogy, Plate 4. Fig. 36.

As the Segment AD	108
To the Side AC	180
So is the Radius	100000
To the Secant of the angle A, 53°. 8′.	166666

Likewise to find the angle B, make in the right angled Triangle BDC this Analogy,

As the Segment BD	60
To the Side BC	156
So is the Radius	100000
To the Secant of the Angle B, 67°. 23′.	260000

The Fractions which happen commonly in the Segments AD, BD, may cause an error of some minutes in the angles; wherefore to find these angles more exactly, for example the angle A, which is acute, as is known *by* 13. 2. use this Canon, *Multiply the excess of the Squares of the two Sides AB, AC, which comprehend the Angle A requir'd, above the Square of the third Side BC, by the Radius, and divide the Product by double the Product under the two same Sides AB, AC, and the Quotient will be the Sine Complement of the Angle A requir'd.*

SCHOLIUM.

It is evident that the Segments AD, BD, will be equal to each other, and each will be equal to half the Base AB, when the two sides AC, BC, are equal to each other, and when the three sides are equal, each of the angles will be 60 degrees.

BOOK III.
OF
SPHERICAL Trigonometry.

SPHERICAL TRIGONOMETRY teaches the manner of computing the parts of a ſpherical Triangle, by reaſonings which are drawn from its Properties, and are very different from thoſe of the right lined Triangle, as will be ſhewn in

CHAP. I.

Of THEOREMS.

TO render the Operations of ſpherical Triangles eaſily perform'd, it is more proper to ſeparate the Theory from the Practice, as we have done in Right-lined Trigonometry, becauſe the Properties of Spherical Triangles are more in number, and of a higher nature.

THEOREM I.

The common Section of a Plane and a Sphere is a Circle.

Plate 4. Fig. 37. FIrſt I ſay, that if you cut the Sphere ABCD, whoſe Centre is E, by the Plane ADGF, which paſſing thro' the

the Centre E, ſo that the ſection of this Plane, and of the ſurface of the Sphere be the Curve line AFGD, the ſection of the cutting Plane and of the Sphere, part whereof is here repreſented by the Plane AEDGF, is a Circle, whoſe Centre is E, and AFGD the Circumference. Plate 4. Fig. 37.

DEMONSRATION.

Since the cutting Plane paſſes thro' the Centre E of the Sphere, all right lines drawn from the Centre E on the Plane, thro' all the Points of the common ſection AFGD, as EA, EF, EG, ED, will be equal to each other *by Def.* 7. Wherefore *by Def.* 1. the Curve line AFGD will be the Circumference of a Circle, whoſe Centre is the ſame with the Centre E of the Sphere; and the common ſection of the cutting Plane and of the Sphere, which is terminated by this Circumference, will conſequently be a Circle. *Which was to be demonſtrated.*

I ſay in the ſecond place, that if you cut the ſame Sphere ABCD, by the Plane BCI, which does not paſs thro' the Centre E of the Sphere, ſo that the ſection of this Plane and of the ſurface of the Sphere be the Curve line BIC; the ſection of the cutting Plane and of the Sphere, one part whereof is here repreſented by the Plane BCI, is a Circle, whoſe Circumference is the Curve line BIC.

PREPARATION.

Cut the Sphere by a Plane, which paſſing thro' the Centre E, is perpendicular to the Plane BCI, and then the ſection of this cutting Plane and of the Sphere will be a Circle, as ABCD, whoſe Centre will be the ſame as the Centre E of the Sphere, as was juſt now ſhewn, and the common ſection of this Circle, and of the Plane BCI, will be the right line BC. Draw on the Plane of the Circle ABCD, from the Centre E, the right line EH perpendicular to the common ſection BC, which will be divided into two equal parts at the point H, *by* 3. 3. ſo that the lines HB, HC, will be equal to each other. Laſtly, draw from this middle point H, thro' the point I taken at diſcretion on the Curve line BIC, the right line HI; and from the Centre E of the Sphere, thro' the points I, B, the right lines EB, EI, which will be equal to each other, ſince they are the Radii of the ſame Sphere.

DEMONSTRATION.

Plate 4. Fig. 37. Since the line EH is perpendicular to the common ſection BC of the two perpendicular Planes ABCD, BCI, and ſince 'tis in the Plane ABCD, it will be perpendicular to the other Plane BCI, and conſequently to the line HI which is in this Plane. So that the Angle EHI will be right, and by 47. 1. the ſquare of the Radius EI will be equal to the ſum of the ſquares HE, HI: and becauſe the ſquare of the Radius EB is alſo equal to the ſum of the ſquares HB, HE, it follows that the ſum of the ſquares HE, HI, is equal to that of the two HB, HE; wherefore by ſubſtracting the common ſquare HE, there will remain the ſquare HI, equal to the ſquare HB, and conſequently the line HB or HC equal to the Line HI. So that the three lines HB, HC, HI, will be equal to each other, and *by* 9. 3. the point H will be the Centre of the Circle, which paſſes thro' the three points B, I, C: From whence it is eaſy to conclude, that the curve line BIC, is the Circumference of this Circle, and conſequently the common ſection of the cutting Plane BCI, and of the Sphere, is a Circle. *Which was to be demonſtrated.*

THEOREM II.

If from the angular Point of a ſpherical Angle, as a Pole, you deſcribe with an interval of 90 Degrees, a great Circle, the Arc of this Circle included between the Sides of the Angle, will be the Meaſure of that ſame Angle.

Fig. 38. WE ſaid in *Def.* 11. that the meaſure of a ſpherical angle is the arc of a great Circle deſcrib'd from its angular point, and terminated by the two ſides of the angle; and to ſhew you the reaſon of this Definition, ſuppoſe the ſpherical angle BAD, be made by the inclination of the two great Circles ABC, ADC, whoſe common Centre is E, and the common ſection is the right line AC, which ſhould of neceſſity be a common Diameter, ſince it paſſes thro' their common Centre E. From whence it follows that ABC, ADC, are two Semicircles, and that all the great Circles of the Sphere cut each other in two equal parts: I ſay, that if from the point A, as Pole, you deſcribe with an interval of a Quadrant AB, or AD, the arc BD, which will neceſſarily be an arc of a great Circle, this arc BD is the meaſure of the angle BAD.

Plate 4. Fig. 38.

DEMONSTRATION.

If you draw on the Plane of the Circle ABC, the Radius EB, the rectiline angle AEB will be a right one, becaufe it is meafur'd by the Quadrant AB : and likewife if you draw the Radius ED on the Plane of the Circle ADC, the angle AED will be alfo a right one, becaufe it is meafur'd by the Quadrant AD. Since then the two Radii BE, DE, are each perpendicular to the common fection AC of the two Planes ABC, ADC, in which they are, the angle BED form'd by them, will be the inclination of thefe two Planes: and as this right lined angle BED is meafured by the arc BD, whofe Centre is E, becaufe all great Circles have their Centre common with that of the Sphere, as is eafily feen by the preceding Theorem, it follows that this arc BD is alfo the meafure of the fpherical angle BAD. *Which was to be demonftrated.*

SCHOLIUM.

It is alfo evident, that the arcs BC, DC, are alfo Quadrants, becaufe of the Semicircle ABC, ADC, and that the point C, as well as the point A, is the Pole of the arc BD, which fhould confequently meafure the fpherical angle BCD, which is therefore equal to the fpherical angle BAD. From whence it follows that two fpherical angles, diftant from each other by a Semicircle, are equal; and that the fide of a fpherical Triangle is always lefs than a Semicircle; and laftly that two fides of a fpherical Triangle, as AB, AD, being produc'd till they meet in a point as C, will each become a Semicircle. From wherce it follows, that when two Circumferences of great Circles interfect, they form two angles, which taken together make 180 degrees, becaufe they are meafur'd by two arcs whofe fum is a Semicircle. Fig. 39.

THEOREM III.

A Circle of the Sphere is cut at right angles, and in two equal parts, by a great Circle which paffes thro' its Poles.

First I fay, that if in the Circle BEDF, whether great or fmall, whofe two Poles are A, C, thro' which the great Circle ABCD paffes, this great Circle ABCD cuts the Circle BEDF into two equal parts, fo that each part BED, BFD, is a Semicircle; that is to fay, the common Fig. 39.

Plate 4. Fig. 39. section BD of the Planes ABCD, BEDF, is the Diameter of the Circle BEDF.

DEMONSTRATION.

If you join the two Poles A, C, by the right line AC, which cuts the Circle BEDF in the point G, this line AC will be a Diameter of the Sphere, and consequently of the great Circle ABCD, because *by Def.* 10. the two Poles of a Circle are two points in the surface of the Sphere, equally distant from the Circumference of this Circle, and consequently diametrically opposite, which shews that the two arcs AB, AD, are equal to each other, as well as the two CB, CD, and that *by* 3. 3. the Diameter AC divides the common section BD at right angles, and in two equal parts in the point G. From whence it is easy to conclude that the point G is the Centre of the Circle BEDF; and consequently BD its Diameter. *Which was to be demonstrated.*

In the second place I say, that the Circle ABCD is perpendicular to the Circle BEDF, as will appear by drawing within this Circle BEDF, any Diameter whatsoever EF, and joining the right lines AE, AF, which will be equal to each other, because the point A being the Pole of the Circle BEDF, is equally distant from its Circumference.

DEMONSTRATION.

Since the line AE is equal to the line AF, and the Radius GE to the Radius GF, and the line AG common to the two Triangles AGE, AGF, it follows *by* 8. 1. that the angle AGE is equal to the angle AGF, and consequently the line AG is perpendicular to the line EF, and likewise, as has been demonstrated, perpendicular to the line BD, it will be perpendicular to the Plane BEDF, *by* 4. 11. and *by* 18. 11. the Plane ABCD, in which this line is, will be also perpendicular to the Plane BEDF. *Which was to be demonstrated.*

SCHOLIUM.

The reverse of this Theorem is also true, namely, *that one Circle passes thro' the Poles of another when it is perpendicular to it,* because this Circle not inclining more to one
Fig. 38. side than another, with respect to the other, to which it is perpendicular, must necessarily pass thro' a point which is equally

equally diſtant from the Circumference of this other; that is to ſay, thro' the Pole. From whence it follows, that if two angles of a ſpherical Triangle are right, as B, D, of the ſpherical Triangle ABD, the angular point of the third angle A will be the Pole of its oppoſite ſide BD, and each of the other ſides AB, AD, will be a Quadrant. Plate 4. Fig. 38.

THEOREM IV.

If two ſpherical Triangles have two Sides in each reſpectively equal, and the Angle included by theſe two Sides alſo equal; the Baſe of the one will be equal to that of the other, the two other angles in each will be reſpectively equal, and the Triangles will be alſo equal.

I Say, that if the ſide AB of the ſpherical Triangle ABC is equal to the ſide DE of the ſpherical Triangle DEF, the ſide AC equal to the ſide DF, and the included angle A equal to the included angle D; the baſe BC is equal to the baſe EF, the angle B to the angle E, the angle C to the angle F, and the whole Triangle ABC to the whole Triangle DEF. Fig. 40.

DEMONSTRATION.

Imagine the Triangle DEF apply'd on the Triangle ABC, ſo that the ſide DE coincide with the ſide AB, which is poſſible, becauſe theſe two ſides are ſuppos'd equal, and moreover being Arcs of great Circles that are equal, their Curvatures are equal; in which caſe the ſide DF will fall on the ſide AC, becauſe it is ſuppos'd that the two angles A, D, are equal, and the point D falling on the point A, the point F will fall on the point C, becauſe the two ſides AC, DF, are ſuppos'd equal. Wherefore the baſe EF will fall on the baſe BC, becauſe if it ſhould fall on BGC, each of the two Arcs BC, BGC would be a Semicircle, which is impoſſible *by Theor.* 1. where we have obſerv'd that one ſide of every ſpherical Triangle is leſs than a Semicircle; ſo that the baſe BC will be equal to the baſe EF, the angle B to the angle E, the angle C to the angle F, becauſe they coincide, and for the ſame reaſon the whole Triangle ABC will be equal to the whole Triangle DEF. *Which was to be demonſtrated.*

SCHO-

SCHOLIUM.

This Theorem shews us, that a spherical Triangle is sufficiently determined, when two sides and the angle which they comprehend are known; because there cannot be two different Triangles, which have two sides equal to two sides, and the compris'd angle equal.

THEOREM V.

The three Angles of a Spherical Triangle are together greater than two Right-Angles.

Plate 4. Fig. 41. I Say that the three angles A, B, C, of the spherical Triangle ABC, are together greater than two right angles; so that if from these three angles, the three Chords AB, AC, BC, be drawn, which will form a rectilineal Triangle ABC, the three angles of this rectilineal Triangle, which taken together are equal to two right ones, are less than the three angles of the spherical Triangle.

PREPARATION.

Produce any two sides of the spherical Triangle ABC, as AB, AC, until they meet in one point as D, and you have the two Semicircles ABC, ACD; join the right line AD, which will be the common section of the two Planes ABD, ACD. Draw thro' the point E taken at pleasure in this common section BD, on the Plane of each Semicircle ABD, ACD, the right lines EF, EG, perpendicular to the same common section AD, and the angle FEG will represent the inclination of the two Planes ABD, ACD, or the spherical angle A. Lastly, draw the right line FG.

DEMONSTRATION.

Since *by* 19. 1. the side AF is greater than the side EF, of the Triangle AEF, right angled in E, and in like manner the side AG is greater than the side EG, of the Triangle AEG right angled in E, if you imagine the right lined Triangle AFG to move about its Base FG, towards E, until the right lined angle A be in the Plane of the Triangle EFG, the angle FEG will be found to include the right lined Triangle FAG, and it will appear *by* 21. 1. that the right lined angle A is less than the right lined angle FEG,

FEG, or than the ſpherical angle A. It may be prov'd in the ſame manner, that the ſpherical angle B is greater than the right lined angle ABC, and that the ſpherical angle C is greater the right lined angle ACB. From whence it follows, that the three ſpherical angles A, B, C, are greater than two right ones. *Which was to be demonſtrated.* Plate 4. Fig. 41.

COROLLARY.

It follows from this Theorem, that in every ſpherical Triangle, as ABC, the exterior angle CBD is leſs than the ſum of the two interior oppoſite ones A, C; becauſe the two angles ABC, CBD, make together two right ones, as we have obſerv'd in *Theor.* 2. and the three angles A, B, C, are greater than two right ones, that is to ſay, than the two angles ABC, CBD, *&c.*

THEOREM VI.

The Angles oppoſite to two equal Sides of a ſpherical Triangle, are equal to each other.

I Say, that if the two ſides AC, BC, of the ſpherical Triangle ABC, are equal to each other, their oppoſite angles B and A are alſo equal to each other. Fig. 43.

DEMONSTRATION.

If you ſuppoſe the arc CD, of a great Circle, to divide the angle C into two equal parts, it will appear *by Theor.* 4. that the two Triangles ADC, BDC, are equal to each other, and conſequently that the angles A and B are alſo equal to each other. *Which was to be demonſtrated.*

SCHOLIUM.

The inverſe Theorem is alſo true, namely, that *if the two Angles A and B are equal to each other, their oppoſite Sides BC and AC are alſo equal to each other.* Fig. 44.

DEMONSTRATION.

If you take on the ſide BC the arc BD equal to the ſide AC, without conſidering where the point D falls, and if thro' the two points A, D, you deſcribe the arc AD of a great Circle, it will appear *by Theor.* 4. that the Triangle

Plate 4. Fig. 44. gle ABD is equal to the Triangle ABC; so that the angle BAD must be equal to the angle B, and consequently to the angle BAC. From whence it follows that the arc AD coincides with the side AC, and the point D with the point C, and that thus the side BC is equal to the arc BD, that is to say, to the side AC. *Which was to be demonstrated.*

THEOREM VII.

The Sum of any two Sides of a spherical Triangle is greater than the third.

Fig. 45. I Say that the sum of the two sides AC, BC, of the spherical Triangle ABC, is greater than the third side AB, which I suppose the greatest of all, otherwise the Theorem would be evident.

PREPARATION.

From the end B of the greatest side AB, as a Pole, thro' the point C describe the arc CD, which *by Theor.* 3. will cut the side AB at right angles, between A and B, because the side AB is suppos'd greater than the side BC. Describe again from the other end A of the same great side AB, thro' the point D, the arc DE, which will cut the side AB also at right angles, and the side AC in the point E, between A and C, because the two angles which are made at the point D, being right ones, the two arcs CD, DE, ought to touch there, and that thus the arc DE is remov'd from the point C towards A.

DEMONSTRATION.

Since the arc BD is equal to the side BC, and the arc AD to the arc AE, *by constr.* the sum of the two arcs AD, BD, that is to say, the side AB, is equal to the sum of the two arcs AE, BC, and consequently less than the sum of the two arcs AC, BC. *Which was to be demonstrated.*

COROLLARY.

It follows from this Theorem, that the three sides of a Fig. 41. spherical Triangle, as ABC, are together less than four right ones, or than two Semicircles, as ABD, ACD, made by

by producing the two ſides AB, AC, until they meet in D; becauſe the ſide BC of the Triangle BCD, is leſs than the ſum of the two others AD, CD, *&c.*

THEOREM VIII.

The Side oppoſite to the greateſt Angle of a ſpherical Triangle is greater than that which is oppoſite to a leſs Angle.

I Say, that if the angle C of the ſpherical Triangle ABC, is greater than the angle B, the ſide AB oppoſite to the greateſt angle C, is greater than the ſide AC oppoſite to the leſſer angle B. Plate 4. Fig. 45.

DEMONSTRATION.

If from the greateſt angle C you take away the angle BCD, equal to the angle B, it will appear *by Theor.* 6. that the two arcs BD, CD, are equal to each other, and *by Theor.* 7. that the ſum of the two arcs AD, CD, or AD, BD, or AB, is greater than AC. *Which was to be demonſtrated.*

SCHOLIUM.

The inverſe Theorem is alſo true, namely, that *the Angle oppoſite to the greateſt Side of a ſpherical Triangle is greater than the Angle oppoſite to a leſs Side*; that is to ſay, that if the ſide AB is greater than the ſide AC, the angle C is greater than the angle B, becauſe it cannot be equal to it, nor leſs; for if it was equal to it, the ſide AB would be equal to the ſide AC, *by Theor.* 6. which is contrary to the ſuppoſition; and if it was leſs, the ſide AB would be alſo leſs than the ſide AC, as was juſt now ſhewn, which is likewiſe contrary to the ſuppoſition.

THEOREM IX.

One Side of a ſpherical Triangle being produc'd, the exterior Angle is equal to the interior oppoſite on the ſame Side, when the Sum of the two other Sides is a Semicircle; and it is leſs, when the Sum is greater than a Semicircle; and laſtly greater, when the ſame Sum is leſs than a Semicircle.

FIrſt I ſay, that the ſide AC of the ſpherical Triangle ABC, being produc'd towards D, the exterior angle BCD is equal to the interior oppoſite A on the ſame ſide, if the ſum of the two other ſides AB, BC, is equal to a Semicircle. Fig. 41.

DE-

Plate 4. Fig. 41.

DEMONSTRATION.

By producing the side AB until it meets the other side AC produc'd, in a point as D, it will appear without trouble that ABD is a Semicircle, and that consequently the arcs BC, BD are equal to each other, because it is suppos'd that AB and BC make together a Semicircle; wherefore *by Theor* 6. the angle BCD will be equal to the angle D, or to the angle A. *Which was to be demonstrated.*

Secondly I say, that the exterior angle BCD is less than the interior opposite A on the same side, if the two sides AB, BC make together more than a Semicircle.

DEMONSTRATION.

Since the two sides AB, BC are together greater than the Semicircle ABD, the side BC will be greater than the side BD, and *by Theor.* 8. the angle BCD will be less than the angle D, or A. *Which was to be demonstrated.*

Lastly I say, that the exterior angle BCD is greater than the interior opposite A on the same side, if the two sides AB, BC are together less than a Semicircle.

DEMONSTRATBON.

Since the two sides AB, BC, make together less than the Semicircle ABD, the side BC will be less than the side BD, and *by Theor.* 8. the angle BGD will be greater than the angle D, or A. *Which was to be demonstrated.*

COROLLARY.

It follows from this Theorem, that in a spherical Triangle the sum of any two sides is of the same affection with the sum of their adjacent angles, that is to say, if the two sides AB, BC, make together a Semicircle or 180 degrees, the two adjacent angles A, C, make likewise together 180 degrees, because in this case the angle A or D was shewn to be equal to the angle BCD, which with the angle ACB makes 180 degrees. Likewise if the two sides AB, BC, make together more than 180 degrees, the two adjacent angles also A, C, make together more than 180 degrees, because in this case it was shewn that the angle A is greater than the angle BCD. Lastly, if the two sides

ſides AB, BC are together leſs than 180 degrees, the two adjacent angles A, C, are likewiſe leſs than 180 degrees, because in this caſe the angle A was ſhewn to be leſs than the angle BCD. Plate 4. Fig. 41.

THEOREM X.

Each of the two oblique Angles of a right angled ſpherical Triangle is of the ſame affection with its oppoſite Side.

FIrſt I ſay, that if the ſide AC of the ſpherical Triangle ABC right angled in A, is leſs than a Quadrant, its oppoſite angle B is acute. Fig. 42.

DEMONSTRATION.

If you produce the ſide AC to D, ſo that AD be a Quadrant, and if thro' the two points B, D, you deſcribe an arc of a great Circle BD, it will appear *by Theor.* 3. that ſince the angle A is a right one, and AD a Quadrant, the point D is the pole of the arc AB, and conſequently the angle ABD is a right one. From whence it follows that the angle ABC is acute. *Which was to be demonſtrated.*

Secondly I ſay, that if the ſide AC of the ſpherical Triangle ABC right angled in A, is greater than a Quadrant, its oppoſite angle B is obtuſe. Fig. 45.

DEMONSTRATION.

If you cut from the ſide AC the quadrantal arc AD, and thro' the two points B, D, you deſcribe an arc of a great Circle BD, it will appear that the point D is the Pole of the arc AB, and that the angle ABD is a right one. From whence it follows that the angle ABC is obtuſe. *Which was to be demonſtrated.*

Laſtly I ſay, that if the ſide AC of the ſame Triangle ABC is a Quadrant, its oppoſite angle B will be a right one; becauſe in this caſe the point C will be the Pole of the arc AB, and the angle B will conſequently be a right one. *Which remain'd to be demonſtrated.*

THEO-

THEOREM XI.

If the two Sides of a right angled Spherical Triangle are each acute or obtuse, the Hypotenuse will be less than a Quadrant; and if one is acute and the other obtuse, the Hypotenuse will be greater than a Quadrant.

Plate 5. Fig. 48. FIrst I say, that if each of the two sides AB, BC, of the spherical Triangle ABC right angled in B, be acute, the Hypotenuse AC is less than a Quadrant.

PREPARATION.

Produce the side AB to D, and the side BC to F, until the arcs AD, BF are each a Quadrant; and thro' the two points D, F, describe the arc of a great Circle DEF, which cuts here the Hypotenuse AC produc'd in the point E.

DEMONSTRATION.

Since the angle B is a right one, and BF a Quadrant, the point F will be the Pole of the arc ABD, *by Theor.* 3. and the angle D will be also a right one, and since AD is also a Quadrant, the point A will be the Pole of the arc DE, and AE will be a Quadrant; and the Hypotenuse AC will consequently be less than a Quadrant. *Which was to be demonstrated.*

Fig. 49. Likewise I say, that if each of the two sides AB, BC of the spherical Triangle ABC right angled in B, is obtuse, the Hypotenuse AC is less than a Quadrant.

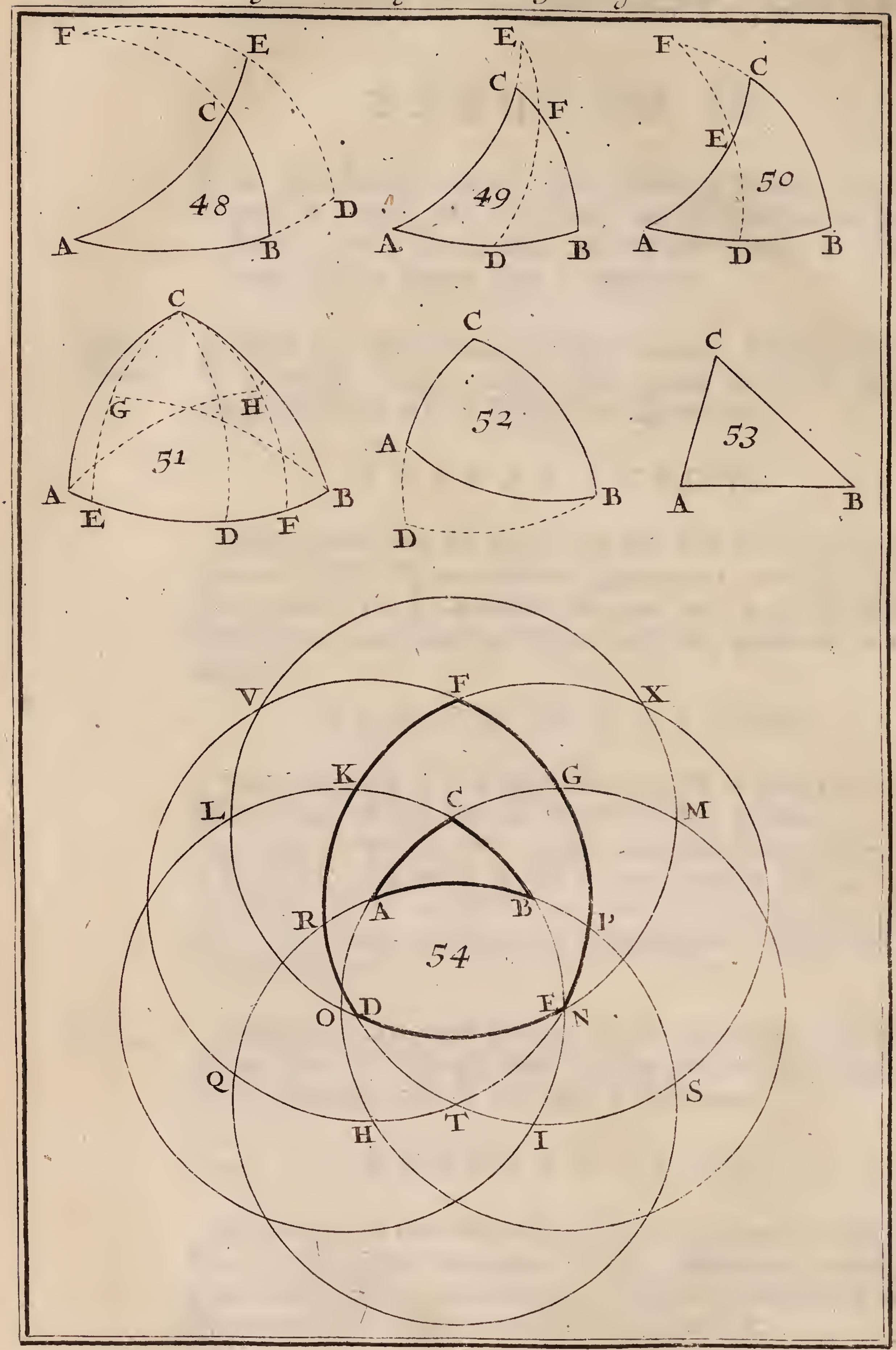
PREPARATION.

Cut from the two sides AB, BC the quadrantal arcs AD, BF, and thro' the two points D, F, describe an arc of a great Circle DFE, which being produc'd, meets here the Hypotenuse AC, also produc'd, in the point E.

DEMONSTRATION.

By considering the preceding Demonstration, it will appear as before, that the arc AE is a Quadrant, and that conse-

Trigonometry Plate 5. Page 101.



consequently the Hypotenuse AC is less than a Quadrant. *Which was to be demonstrated,* Plate 5. Fig. 49.

Secondly I say, that if the side AB be obtuse, and the side BC acute, of the Spherical Triangle ABC right angled in B, the Hypotenuse AC is greater than a Quadrant. Fig. 35.

PREPARATION.

Having cut from the side AB, the quadrantal arc AD, and produc'd the other side BC to F, so that BF be a Quadrant, thro' the two points D, F, describe an arc of a great Circle DEF, which cuts here the Hypotenuse AC in the point E.

DEMONSTRATION.

By considering likewise the preceding Demonstration, it will appear as before that the arc AE is a Quadrant, and that consequently the Hypotenuse AC is greater than a Quadrant. *Which remain'd to be demonstrated.*

SCHOLIUM.

It is evident that if each of the two sides AB, BC, was a Quadrant, the Hypotenuse AC wou'd be also a Quadrant; because in this case the three angles of the Triangle ABC wou'd be right ones, *by Theor.* 10. and *by Theor.* 3. each of their angular points wou'd be the Pole of its opposite side, and consequently the Hypotenuse AC a Quadrant.

COROLLARY I.

It follows from this Theorem, that *if the two oblique angles of a Spherical Triangle are of the same affection, the Hypotenuse will be less than a Quadrant, and greater if they are of a different affection,* because *by Theor.* 10. these angles are of the same affection with their opposite sides.

COROLLARY II.

It also follows, that *if the Hypotenuse of a right-angled Spherical Triangle be less than a Quadrant, the two sides, or rather the two oblique angles will be both of the same affection, and of different affection if the Hypotenuse be greater than a Quadrant;* since if in the first case, the two sides were of a different affection, the Hypotenuse wou'd be greater than a Quadrant, as was demonstrated, which is contrary to the Supposition in this first case; and if in the second case the two sides were of

Plate 5. Fig. 50. the ſame affection, the Hypotenuſe wou'd be leſs than a Quadrant, as was likewiſe demonſtrated, which is contrary to the Suppoſition in this ſecond caſe.

COROLLARY III.

It likewiſe follows, that *if the Hypotenuſe, and one ſide, of a right-angled Spherical Triangle be of the ſame affection, the other ſide, or rather its oppoſite angle, will be acute, and obtuſe if they be of different affection*; becauſe *by Coroll.* 2. if the Hypotenuſe and one ſide be each leſs than a Quadrant, the other ſide will alſo be leſs than a Quadrant, and greater if the Hypotenuſe and one ſide be each greater than a Quadrant: but if the Hypotenuſe and one ſide be of different affection, ſo that the Hypotenuſe is, for example, greater than a Quadrant, and conſequently one ſide acute, the other ſide will be obtuſe: and likewiſe if the Hypotenuſe be leſs than a Quadrant, and conſequently one ſide obtuſe, the other ſide will be alſo obtuſe, becauſe in this caſe the two ſides are of the ſame affection, *by Coroll.* 2.

THEOREM XII.

If two Angles of a Spherical Triangle be of the ſame affection, the perpendicular from the third Angle, on its oppoſite ſide, will fall within the Triangle, and without if the two ſame Angles be of different affection.

Plate 4. Fig. 47. Firſt I ſay, that if the two angles A, B, of the Spherical Triangle ABC, be of the ſame affection, for example, each obtuſe, the perpendicular CD, will fall within the Triangle; becauſe if it ſhou'd fall without, as in the Figure, this perpendicular CD being conſider'd in the right-angled Triangle ADC, is *by Theor.* 10. of the ſame affection as its oppoſite angle A, which we have ſuppos'd obtuſe, and conſequently greater than a Quadrant; and that being conſider'd in the right-angl'd Triangle BDC, whoſe angle B is acute, becauſe the angle ABC was ſuppos'd obtuſe, it is leſs than the Quadrant, which is contradictory, and you will find the ſame contradiction, by ſuppoſing each of the two angles A, B, to be acute: Therefore, *&c.*

Fig. 43. Secondly I ſay, that if the two angles A, B, of the Spherical Triangle ABC be of different affection, as if the angle A is acute and B obtuſe, the perpendicular CD will fall without the Triangle; because if it ſhou'd fall within, as in this Figure, this perpendicular CD being conſider'd in the right-angled

gled Triangle ADC, is *by Theor.* 10. of the same affection as its opposite angle A, which we have suppos'd acute, and consequently less than a Quadrant; and that being consider'd in the right-angled Triangle CDB, whose angle B is suppos'd obtuse, it is greater than a Quadrant, which is contradictory, and the same contradiction will happen, by supposing the angle A obtuse and B acute. Therefore, &c. Plate 4. Fig. 43.

THEOREM XIII.

If the two least sides of a Scalene Spherical Triangle be of the same affection, the perpendicular from the greatest Angle on the greatest opposite side will fall within the Triangle.

I say that if from the greatest angle C, form'd by the two least sides AC, BC, of the Scalene Spherical Triangle ABC, you draw the perpendicular CD on the opposite side AB, which is the greatest of any, *by Theor.* 8. this perpendicular CD, will fall within the Triangle ABC. Plate 5. Fig. 51.

PREPARATION.

Cut from the greatest side AB, the part AF, equal to the side AG, and the part BE, equal to the other side BC, and draw arcs of great circles CE, CF. Divide again into two equal parts the angle A, by means of the arc AH of a great circle, which will cut the Base CF of the Isosceles Triangle ACF, at right angles, and in two equal parts in the point H, and likewise the angle B into two equal parts by means of the arc BG of a great Circle BG, which will also divide the Base CE, of the Isosceles Triangle ECB, at right-angles, and into two equal parts in the point G.

DEMONSTRATION.

Since the half FH of the side CF is less than a Quadrant, because the side CF is less than a Semi-circle, *by Theor.* 2. and that the angle H is a right one, the angle FAH will be acute, *by Theor.* 10. Likewise since the half EG of the side CE is less than a Quadrant, because CE is less than a Semi-circle, *by Theor.* 2. and that the angle G is a right one, the angle EBG will be acute, *by Theor.* 10. Now if you suppose that each of the two sides AC, BC, are acute, in which case the Hypotenuse AF, BE, which are their equals, *by Constr.* will each be less than a Quadrant, these angles AFH, BEG will be acute, *by Coroll.* 3. *Theor.* 11. But if you suppose each of the

Plate 5. Fig. 51. the two ſides AC, BC, to be obtuſe, in which caſe the Hypotenuſes AF, BE of the two right-angled Triangles AFH, BFG, will each be greater than a Quadrant, the angles AFH, BEG will be obtuſe, *by Coroll.* 3. *Theor.* 11. Laſtly, if you ſuppoſe each of the two ſides AC, BC, to be a Quadrant, in which caſe the Hypotenuſes AF, BE will each be a Quadrant, the angular point A will be the Pole of the arc FH, and the angular point B the Pole of the arc EG, *by Def.* 10. and *by Theor.* 3. the angles AFH, BEG, will be right ones. Thus you ſee that in all theſe caſes the angles E, F, of the Triangle ECF are of the ſame affection, and that *by Theor.* 10. the perpendicular CD falls within the Triangle ECF, and conſequently within the Triangle ABC. *Which was to be demonſtrated.*

COROLLARY.

It follows from this Propoſition, that the perpendicular CD, and conſequently each of the two leaſt angles A, B, are of the ſame affection with the two leaſt ſides AC, BC; becauſe it was demonſtrated that the two angles E, F of the Triangle ECF, are of the ſame affection with the two leaſt ſides AC, BC. From whence it is eaſy to conclude *by Theor.* 10. that the perpendicular CD, by conſidering it in the Triangle ECF, and the angles A, B, with reſpect to the perpendicular CD, conſider'd in the Triangle ABC, are alſo of the ſame affection with the two ſides AC, BC.

THEOREM XIV.

If two angles, and the included ſide of a Spherical Triangle are obtuſe, the third angle will be alſo obtuſe.

Plate 4. Fig. 41. I ſay that if each of the two angles B, C, of the Spherical Triangle ABC, and the ſide BC included, be obtuſe, the third angle A is alſo obtuſe, becauſe it can neither be right nor acute, which we ſhall ſhew by producing the two ſides AB, AC, until they meet in a point D, and by drawing from the angle B, to its oppoſite ſide AC, the perpendicular BH, which ſhou'd fall within the Triangle ABC, as you'll ſee by the following

DEMONSTRATION.

Firſt, if the angle A was a right one, the angle D its equal wou'd be alſo a right one, and in the right-angled Triangle BCD, whoſe two oblique angles B, C, being acute, and conſequently

ſequently of the ſame affection, becauſe they are the remainder to 180 degrees, of the two angles ABC, ACB, which are ſuppos'd obtuſe, the Hypotenuſe BC wou'd be *by Coroll.* 1. *Theor.* 11. leſs than a Quadrant, which is contrary to the Suppoſition. From whence it follows, that the angle A is not a right one. *Which is one of the two things to be demonſtrated.* Plate 4. Fig. 41.

Secondly, If the angle A was acute, the angle D its equal wou'd be alſo acute, and as the angle BCD is alſo acute, the perpendicular BH wou'd fall within the Triangle BCD, *by Theor.* 12. and becauſe each of the two angles B, C, of the right-angled Triangle BHC, is acute, the Hypotenuſe BC will be leſs than a Quadrant. *by Coroll.* 1. *Theor.* 11. and yet it is ſuppos'd greater. From whence it follows, that the angle A is not acute. *Which remain'd to be demonſtrated.*

THEOREM XV.

If the three Angles of a Spherical Triangle be acute, each ſide will be leſs than a Quadrant.

I ſay that if each of the three angles of the Spherical Triangle ABC be acute, each of its three ſides will alſo be acute, as will appear by drawing from one of its two angles, as from C, to its oppoſite ſide AB, the perpendicular CD, which muſt fall within the Triangle ABC, *by Theor.* 12. Fig. 43.

DEMONSTRATION.

Since the two oblique angles A, C, of the Triangle ADC right-angled in D, are acute, and conſequently of the ſame affection, the Hypotenuſe AC will be leſs than a Quadrant, *by Coroll.* 1. *Theor.* 11. and by the ſame reaſon it will appear, that the Hypotenuſe BC of the rectangled Triangle BDC, is leſs than a Quadrant, and if you let fall from one of the two other acute angles A or B a perpendicular on its oppoſite ſide, it will appear in the ſame manner that the third ſide AB is leſs than a Quadrant. *Which was to be demonſtrated.*

SCHOLIUM.

It will appear in the ſame manner, that *if the Spherical Triangle hath one acute angle, and the other two obtuſe, the ſides are of the ſame affection as their oppoſite angles,* provided you draw the perpendicular from the acute angle; as if the angle C be acute, and the two others A, B obtuſe, the ſide AB will be alſo acute, and the two others AC, BC, will be likewiſe obtuſe.

THEOREM XVI.

If the three sides of a Spherical Triangle are obtuse, the three Angles will be also obtuse.

Plate 4. Fig. 44. I say that if the three sides of the Spherical Triangle ABC be obtuse, the three angles are also obtuse; because if the two sides AC, BC are, for example, the least, and AB the greatest, in which case the two angles A, B, will be also the least, and C the greatest, *by Theor.* 8. each of the two least angles A, B, will be obtuse, *by Coroll. Theor.* 13. wherefore the third and greatest angle C will be also obtuse. *Which was to be demonstrated.*

THEOREM XVII.

If a Spherical Triangle has one side less, the other equal, and the third greater than a Quadrant; the angles opposite to the two least sides will be acute, and that which is opposite to the greatest side will be obtuse.

Plate 5. Fig. 52. I say that if in the Spherical Triangle ABC, the side AC is less than a Quadrant, the side BC equal to a Quadrant, and the third side AB greater than a Quadrant, each of the two least angles AB, is acute, and the greatest C obtuse.

PREPARATION.

From the angle C, compris'd by the two least sides AC, BC, as Pole, with the distance BC equal to a Quadrant, describe the arc of a great Circle BD, which by *Theor.* 3. will cut at right angles the other side AC produc'd in the point D.

DEMONSTRATION.

It is already evident, that the angle ABC is acute, because the point C being the Pole of the arc BD, *by Constr.* the angle CBD is right *by Theor.* 3. It is also evident that the angle BAC is acute, because the angle ABD being acute, and the Hypotenuse AB of the Triangle ADB right-angled in D, being greater than a Quadrant, *by Supp.* the angle BAD it obtuse *by Coroll.* 2 *Theor.* 11. and consequently the angle CAB acute. Lastly it is evident that the third angle C is obtuse, because the side AD of the right-angled Triangle ADB, being

less

lefs than a Quadrant, becaufe of the Quadrant CD, *by Conftr.* and the Hypotenufe AB being greater than a Quadrant, *by fupp.* the other fide BD will be obtufe, *by Coroll.* 3. *Theor.* 11. and as this fide BD meafures the angle C, *by Theor.* 2. It follows that the angle C is alfo obtufe. *Which was to be demonftrated.* Plate 5. Fig. 52.

THEOREM XVIII.

There may be two unequal Spherical Triangles, which have two angles in each refpectively equal, and one equal fide oppofite to a fame angle.

If the two fides AC, BC, of the Spherical Triangle ABC, make together a Semicircle, and if you produce the third fide AB towards D, the exterior angle CBD will be equal to the interior oppofite A of the fame fide, *by Theor.* 9. Wherefore if thro' the point C, and thro' the point D, taken at pleafure in the fide AB produc'd, you defcribe the arc of a great circle CD, you will have two different Triangles ADC, BDC, having the angle D common, the angle B equal to the angle A, and the fide CD common, which is oppofite to the equal angles A, B. *Which was to be demonftrated.* Plate 4. Fig. 47.

SCHOLIUM.

It is evident, that fince the two fides AC, BC, make together a Semicircle, if one of thefe two is acute, the other fhou'd be obtufe. Wherefore if the two angles A, D, of the Triangle ADC, which are the fame with the two B, D, of the Triangle BDC, be known, and the fide CD oppofite to the given angle A or B, and you wou'd find the fide AC in the Triangle ADC, or BC in the Triangle BDC; you fhou'd know whether this fide AC or BC is acute or obtufe, becaufe it may be either, the fame thing remaining known.

THEOREM XIX.

If two Spherical Triangles have two fides in each refpectively equal, and the bafe of the one equal to that of the other, thefe two Triangles will be equal, and the angles compris'd by the equal fides, will be equal.

I fay that if the fide AB of the Spherical Triangle ABC, be equal to the fide DE of the Spherical Triangle DEF, the fide Fig. 48.

Plate 4. Fig. 40. AC to the side DF, and the base BC to the base EF, the two Triangles ABC, DEF, are absolutely equal.

PREPARATION.

From the point B thro' the point A, describe the arc of a circle GH, which is done with the distance of the side DE, suppos'd equal to the side AB; and from the point C thro' the point A, describe the arc of a circle IK, which is done with the distance of the side DF, suppos'd equal to the side AC.

DEMONSTRATION.

If you imagine the Triangle DEF applied on the Triangle ABC, so that the base EF coincides with the base AB, which is possible, because they are suppos'd equal, the point D will be in some point of the arc GH, which was describ'd from the point A, with the distance DE, equal to the side AB, and also in ~~the~~ same point of the arc IK, which was describ'd from the point B, with the distance DF equal to the side AC; wherefore 'twill be in the point of their intersection A, and thus the whole Triangle DEF will fall on the whole Triangle ABC, and these two Triangles will be entirely equal. *Which was to be demonstrated.*

SCHOLIUM.

This Theorem shews that a Spherical Triangle is sufficiently determin'd when its three sides are known; because one cannot have two unequal Triangles, whose three sides are equal to each other. The three angles likewise determine a Spherical Triangle, as is easy to conclude by

THEOREM XX.

If from the three angles of a Spherical Triangle, as Poles, you describe three great Circles, these three Circles will form, by their intersections, another Spherical Triangle, each side whereof will be the remainder to 180 degrees of the angle opposite in the given Triangle, and reciprocally each angle will be the remainder to a Semicircle of the side opposite in the given Triangle.

Plate 5. Fig. 54. First, I say, that if from the three angles of the Spherical Triangle ABC, you describe three great circles, which form here the Spherical Triangle DEF, the side DE of this new Triangle is the remainder to 180 degrees of the opposite angle C, the

the side DF, the remainder to 180 degrees off the opposite angle B, and the side EF, the remainder to 180 degrees of the opposite angle A. Plate 5. Fig. 54.

DEMONSTRATION.

Since the point A is the Pole of the arc EF, the arcs AP, AH will be Quadrants, *by Def.* 10. Likewise since the point B is the Pole of the arc DF, the arcs BI, BS, will be Quadrants. Lastly, since the point C is the Pole of the arc DE, the arcs CN, CO, will be Quadrants. Thus the six arcs AP, AH, BI, BS, CN, CO, being Quadrants, will be equal to each other.

Since the arc AB passes thro' the Pole A of the arc EF, and thro' the Pole B of the arc DF, the angles P, Q, R, S, will be right ones *by Theor.* 3. and reciprocally the two arcs EF, DF, will pass thro' the Poles of the arc AB, which consequently will be F, T, where these two arcs EF, DF, intersect, and the arcs FR, FP, will be Quadrants. Likewise since the arc AC passes thro' the Pole A of the arc EF, and thro' the Pole C of the arc DE, the angles G, H, M, O, will be right ones, and reciprocally the two arcs EF, DE, will pass thro' the Poles of the arc AC, which consequently will be E, V, where these two arcs EF, DV, intersect; and the arcs EO, EH, will be Quadrants. Lastly, since the arc BC passes thro' the Pole B of the arc DF, and thro' the Pole C of the arc DE, the angles I, K, L, N, will be right ones, and reciprocally the two arcs DF, DE, will pass thro' the Poles of the arc BC, which consequently will be D, X, where these two arcs DF, DE, intersect, and the arcs DL, DI, will be Quadrants. Thus the six arcs FR, FP, EO, EH, DL, DI, being Quadrants, will be equal to each other, and to the preceding six.

Since the arcs EO, DL, are Quadrants, and consequently equal to each other, if from each of these two equal arcs EO, DL, you substract the common part DO, there will remain DE equal to OL: and since the arc OL measures *by Theor.* 2. the angle OCL, which is the remainder to 180 degrees of the angle ACB, it follows that the side DE is equal to the remainder to 180 degrees of the angle C of the Triangle ABC. Likewise since the arcs FR, DI, are Quadrants, and consequently equal to each other, if to each of these two equal arcs FR, DI, you add the common part DR, you will have DF equal to RI; and since the arc RI measures the angle RBI, which is the remainder to 180 degrees of the angle ABC, it follows that the side DF is equal to the remainder to 180 degrees of the angle B of the Triangle ABC. Lastly, Since the two arcs PF, EH, are Quadrants,

Plate 5. Fig. 54. drants, and consequently equal to each other, if to each of these two equal arcs PF, EH, you add the common part PE, you will have EF equal to PH; and since the arc PH measures the angle HAP, which is the remainder to 180 degrees of the angle BAC, it follows, that the side EF is equal to the remainder to 180 degrees of the angle A of the Triangle ABC. *Which was to be demonstrated.*

Secondly I say, that reciprocally all the angles of the Triangle DEF, are equal to the remainders to 180 degrees of the opposite sides in the Triangle ABC, that is to say, the side AB is equal to the remainder to 180 degrees of the opposite angle DFE, the side BC equal to the remainder to 180 degrees of the opposite angle EDF, and the side AC equal to the remainder to 180 degrees of the opposite angle DEF.

DEMONSTRATION.

If from the two Quadrants AP, BS, you substract the common part BP, there will remain the side AB, equal to the arc PS, that is to say, to the angle PTS, which is the remainder to 180 degrees of the angle DTE, or DFE, its equal. Likewise, if from the Quadrants CN, BI, you substract the common part BN, there will remain the side BC equal to the arc NI, that is to say, to the angle NDI, which is the remainder to 180 degrees of the angle EDF. Lastly, if from the Quadrants CO, AH, you substract the common part AO, there will remain the side AC equal to the arc OH, that is to say, to the angle OEH, which is the remainder to 180 degrees of the angle DEF. *Which was to be demonstrated.*

SCHOLIUM.

This Theorem shews, that a Spherical Triangle, as ABC, is sufficiently determin'd by 'tis three given angles, because one may suppose the other Spherical Triangle DEF, whose three sides are the remainders to 180 degrees of the angles in the Triangle ABC, and consequently known, which determine the Triangle DEF, *by Theor.* 12, and consequently the Triangle ABC.

THEO-

THEOREM XXI.

The Sum of the Sines of any two Angles, is to the difference of the ſame Sines, as the Tangent of half the Sum of the ſame two Angles, is to the Tangent of half their difference.

IMagine any rectilineal Triangle ABC; I ſay that the Sum of the Sines of the two angles A, B, is to the difference of the ſame Sines, as the Tangent of half the Sum of the ſame angles A, B, is to the Tangent of half their difference. Plate 5. Fig. 53.

DEMONSTRATION.

Since the Sines of the two angles A, B, are in the ſame Ratio as their oppoſite ſides BC, AC, *by Theor.* 4. *chap.* 1. *l.* 2. you may take theſe two ſides BC, AC, for the Sines of their oppoſite angles A, B: Wherefore, *by Theor.* 6. *chap.* 1. *l.* 2. there will be the ſame Ratio of the Sines of the two angles A, B, to the difference of the ſame Sines, as of the Tangent of half the Sum of the ſame angles A, B, to the Tangent of half their difference. *Which was to be demonſtrated.*

THEOREM XXII.

In a right-angled Spherical Triangle, the Radius is to the Sine of one of the two ſides, as the Tangent of the angle adjacent to this ſide, is to the Tangent of the other ſide oppoſite to this angle.

I Say that in the Spherical Triangle ABC right-angled in C, the Radius is to the Sine of the ſide AC, as the Tangent of the angle A adjacent to the ſide AC, is to the Tangent of the other ſide BC oppoſite to the ſame angle A. Plate 6. Fig. 56.

PREPARATION.

Produce the ſide AC, and the Hypotenuſe AB, to the points D, E, ſo that AD, AE, be Quadrants, and deſcribe from the Pole A, thro' the two points D, E, the arc of a great Circle DE, which will be the meaſure of the angle A, *by Theor.* 2. Draw from the Centre F of the Sphere thro' the points A, B, C, D, E, the Radii FA, FB, FC, FD, FE, and from the point C, draw CH perpendicular to the Radius FC, which meeting the Radius FB produc'd in H, will be the

Tangent

Plate 6 Fig. 56.

Tangent of the side BC, *by Def.* 18. and from the point D, draw DG perpendicular to the Radius FD, which meeting the Radius FE produc'd in G, will be the Tangent of the arc DE, or of the angle A. Again from the point C, draw CI perpendicular to the Radius FA, which will be the Sine of the side AC, *by Def.* 16. and join the right line HI, which will be in the Plane of the arc AC, as the Tangent CH is in the Plane of the arc BC, which is perpendicular to the Plane of the arc AC, since it is suppos'd that the spherical angle ACB is a right one, and also since the Tangent DG is in the Plane of the arc DE, which is perpendicular to the Plane of the arc AD, since the spherical angle ADE is a right one, *by Theor.* 3.

DEMONSTRATION.

Since the Tangent CH is perpendicular to the Radius FC, which is the common Section of the two perpendicular Planes AC, BC, and that it is in the Plane BC, it will be perpendicular to the other Plane AB, and consequently to the Sine CI which is in this Plane. So that the angle ICH is a right one, and consequently equal to the angle FDG, which is also right, *by Constr.* Likewise, since the Tangent DG is perpendicular to the Radius FD, which is the common Section of the two perpendicular Planes AD, DE, and that it is in the Plane DE, it will be perpendicular to the other Plane AD, or AC, and consequently parallel to the Tangent CH, *by* 6. 11. since this Tangent CH was demonstrated to be perpendicular to the same Plane AC. Lastly, since the Sine HI is perpendicular to the Radius FA, *by Def.* 16. and since the line FG is likewise perpendicular to the Radius FA, by reason of the Quadrant AE, which measures the right-angle AFE, *by Def.* 11. the two lines FG, HI, will be parallel to each other, *by* 28, 1. and *by* 10. 11. the two angles G, H, will be equal to each other: wherefore *by* 32. 1. the two right-angled Triangles CHI, FGD, will be equiangled, and *by* 4. 6. the Radius FD is to the sine CI of the side AC, as the Tangent DG of the angle A, to the Tangent CH of the side BC. *Which was to be demonstrated.*

SCHOLIUM.

One may prove in the same manner, that the Radius is to the Sine of the side BC, as the Tangent of the angle B, to the Tangent of the other side AC, by producing the side BC, instead of the side AC.

COROL.

COROLLARY.

It follows from this Theorem, that if in the right-angled Triangle ABC, the two ſides AC, BC, be known, you may find either of the two oblique angles A, B; and that if in the ſame right-angled Triangle ABC, one ſide and the adjacent oblique angle be known, you may find the ſide oppoſite to this angle. Plate 6. Fig. 55.

THEOREM XXIII.

In a right-angled Spherical Triangle, the Radius is to the Sine of the Hypotenuſe, as the Sines of one of the two oblique angles, is to the Sine of its oppoſite ſide.

I Say that in the ſpherical Triangle ABC right-angled in C, the Radius is to the Sine of the Hypotenuſe AB, as the Sine of the angle A, is to the Sine of its oppoſite ſide BC. Fig. 55.

PREPARATION.

Produce the ſide AC, and the Hypotenuſe AB, to the points D, E, ſo that AD, AE, be Quadrants, and deſcribe from the Pole A, thro' the points E, D, the arc of a great Circle DE, which will be the meaſure of the angle A, *by Theor.* 2. Draw from the Centre F of the Sphere, thro' the points A, C, D, E, the Radii FA, FC, FD, FE, and from the point B, draw BH perpendicular to the Radius FA, which will be the Sine of the Hypotenuſe AB; and BI perpendicular to the Radius FC, which will be the Sine of the ſide BC. Again from the point E, draw EG perpendicular to the Radius FD, which will be the Sine of the arc ED, or of the angle A; join the right line HI.

DEMONSTRATION.

Since the Sine BI is perpendicular to the Radius FC, which is the common Section of the perpendicular Planes AC, BC, and ſince it is in the Plane BC, it will be likewiſe perpendicular to the other Plane AC, and conſequently to the line HI which is in this Plane. Thus the Triangle HIC is right-angled in I. Likewiſe ſince the Sine EG is perpendicular to the Radius FD, which is the common Section of the two perpendicular Planes AD, DE, and ſince it is in the Plane DE, it

will

Plate 6. Fig. 55. will be alſo perpendicular to the other Plane AD, and *by* 6. 11. it will be parallel to the Sine BI, which was demonſtrated to be perpendicular to the ſame Plane AD, or AC. Laſtly, ſince each of the two lines BH, EF, is perpendicular to the ſame FA, they will be parallel to each other, *by* 28. 1. and *by* 10. 11. the two angles FEG, HBI, will be equal to each other: Wherefore *by* 32. 1. the two right-angled Triangles EFG, BIH, will be equi-angled, and *by* 4. 6. the Radius EF, is to the Sine BH of the Hypotenuſe AB, as the Sine EG of the angle A, to the Sine BI of the oppoſite ſide BC. *Which was to be demonſtrated.*

SCHOLIUM.

One may ſhew in the ſame manner, that the Radius is to the Sine of the ſame Hypotenuſe AB, as the Sine of the other oblique angle B, to the Sine of its oppoſite ſide AC, by producing the ſide BC, inſtead of the ſide AC. From whence it is eaſy to conclude, that the Radius being the Sine of the right-angle C, which is oppoſite to the Hypotenuſe BC, the Sines of the three ſides of a right-angled ſpherical Triangle are proportional to the Sines of the oppoſite angles. This is alſo true in an oblique-angled ſpherical Triangle, as will be ſhewn in the following Theorem.

COROLLARY.

It follows from this Theorem, that if in the right-angled ſpherical Triangle ABC, the Hypotenuſe AB, and one of the two ſides AC, BC be known, you may find the oblique angle oppoſite to this ſide: and that if in the ſame Triangle ABC, the Hypotenuſe and an oblique angle be known, you may find the ſide oppoſite to this angle: and again, if you know one ſide and its oppoſite angle, you may find the Hypotenuſe. It follows alſo, that when the Hypotenuſe is a Quadrant, each oblique angle will be equal to its oppoſite ſide.

THEOREM XXIV.

In every Spherical Triangle, the Sines of the ſides are proportional to the Sines of the Angles oppoſite to theſe Sides.

Plate 4. Fig. 43. I Say that in the ſpherical Triangle ABC, whether right-angled or oblique-angled, the Sine of the angle A, is to the Sine of its oppoſite ſide BC, as the Sine of the angle B, is to the Sine of its oppoſite ſide AC.

DEMON-

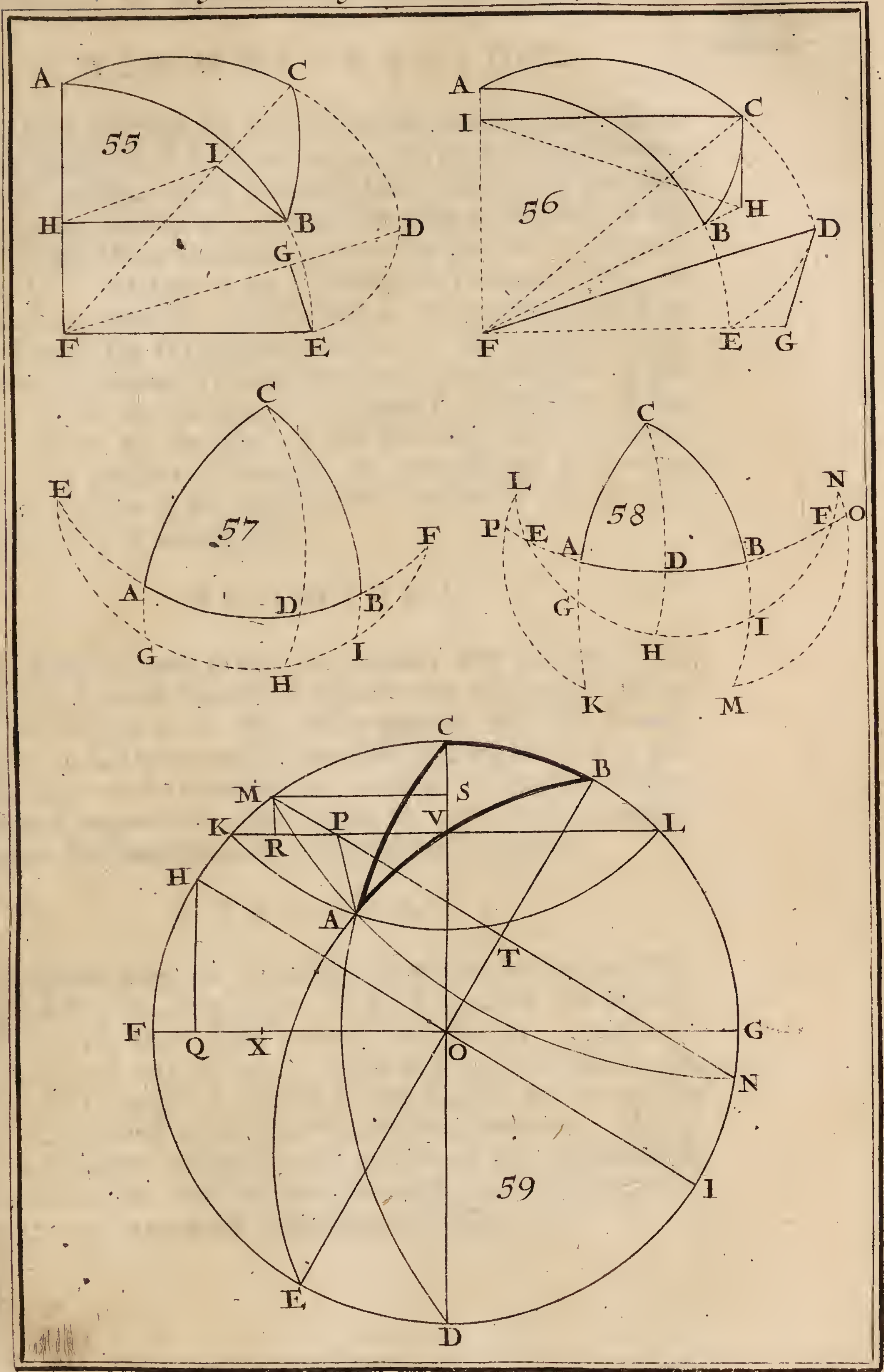

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Plate 4. Fig. 43.

DEMONSTRATION.

If from the angle C, you let fall the perpendicular CD on the opposite side AB, it will appear, *by the preceding Theorem*, that in the right-angled Triangle ADC, the Sine of the angle A is to the Sine of its opposite side CD, as the Sine of the right-angle D, or the Radius, is to the Sine of the Hypotenuse AC: and that in the right-angled Triangle BDC, the Sine of the side CD, is to the Sine of its opposite angle B, as the Sine of the Hypotenuse BC, is to the Radius: From whence it follows, *ex æquo perturbata*, that the Sine of the angle A, is to the Sine of the angle B, as the Sine of the side BC, is to the Sine of the side AC, and *by alternation*, that the Sine of the angle A, is to the Sine of the side BC, as the Sine of the angle B, is to the Sine of the side AC. *Which was to be demonstrated.*

SCHOLIUM.

It may be shewn in the same manner, that the Sine of the angle A, is to the Sine of its opposite side BC, as the Sine of the angle C, is to the Sine of its opposite side AB, namely by letting fall from one of the other two angles A, B, a perpendicular on the opposite side, without taking notice, whether this perpendicular falls within or without the Triangle, because the Demonstration will be always the same.

COROLLARY.

It follows from this Theorem, that if in the spherical Triangle ABC, the two angles, as A, B, and the side BC opposite to the angle A be known, the side AC, opposite to the angle B may be found: and that if the two sides as AB, BC, and the angle A opposite to the side BC be known, the angle C opposite to the other side AB may be found. But in the first Case an Ambiguity may arise about the side requir'd, because this side may be acute or obtuse, the same things being known, as we have demonstrated in *Theor.* 18.

THEO.

THEOREM XXV.

In a Spherical Triangle, the Sines of the Segments of the Base, made by the perpendicular let fall thereon, are reciprocally proportional to the Tangents of the angles adjacent to this Base.

Plate 4. Fig. 43. I Say that in the ſpherical Triangle ABC, whoſe baſe is AB, with reſpect to its perpendicular CD, the Sine of the ſegment AD, is to the Sine of the ſegment BD, as the Tangent of the angle B, to the Tangent of the angle A.

DEMONSRATION.

Since in the right-angled Triangle ADC, the Radius is to the Sine of the arc AD, as the Tangent of the angle A, to the Tangent of the arc CD, *by Theor.* 22 and that likewiſe in the right-angled Triangle BDC, the Sine of the arc BD, is to the Radius, as the Tangent of the arc CD, to the Tangent of the angle B, it follows *ex æquo*, that the Sine of the arc AD, is to the Sine of the arc BD, as the Tangent of the angle B, to the Tangent of the angle A. *Which was to be demonſtrated.*

THEOREM XXVI.

In a Spherical Triangle, the Sine complements of the Segments of the Baſe, made by its perpendicular, are proportional to the Sine complements of the two other ſides.

Plate 6. Fig. 57. I Say, that in the ſpherical Triangle ABC, whoſe baſe is AB, with reſpect to its perpendicular CD, the Sine complement of the Segment AD, is to the Sine complement of the ſegment BD, as the Sine complement of the ſide AC, to the Sine complement of the ſide BC.

PREPARATION.

Deſcribe from the point C, as a Pole, at a Quadrants diſtance, the arc of a great Circle EHF, which cuts here the baſe AB produc'd in the points E, F, the ſide AC in the point G, the perpendicular CD in the point H, and the other ſide BC in the point I, ſo that the two arcs CG, CI, will be Quadrants, and the three angles G, H, I, will be right ones,

by

by Theor. 3. so that by reason of the right angle D, the two point E, F, will be the Poles of the arc CH, and consequently the two arcs DE, DF, are Quadrants. From whence it follows that AE is the complement of the Segment AD, and BF the complement of the Segment BD, and that likewise AC is the complement of the side AC, and BI the complement of the side BC. Plate 6. Fig. 57.

DEMONSTRATION.

Since in the Triangle AGE right-angl'd in G, the Radius is to the Sine of the angle E, as the Sine of the arc AE, or of the complement of the Segment AD, to the Sine of the arc AG, or of the complement of the side AC, *by Theor.* 23. and likewise in the Triangle BIF, right-angled in I, the Radius is to the Sine of the angle F, or E its equal, as the Sine of the arc BF, or of the complement of the Segment BD, to the Sine of the arc BI, or of the complement of the side BC; there will be the same ratio of the Sine complement of the Segment AD to the sine complement of the Segment BD, as of the Sine complement of the side AC, to the Sine complement of the side BC. *Which was to be demonstrated.*

THEOREM XXVII.

In a Spherical Triangle, the Sine complements of the two angles made by the perpendicular, are proportional to the Tangent complements of the two sides.

I Say, that in the spherical Triangle ABC, whose base is AB, with respect of its perpendicular CD, the Sine complement of the angle ACD, is to the Sine complement of the angle BCD, as the Tangent complement of the side AC, is to the Tangent complement of the side BC. Fig. 57.

DEMONSTRATION.

Let the preparation be like the preceding, and it will appear *by Theor.* 2. that the measure of the angle ACD is the arc GH, whose complement is EG, and that the measure of the angle BCD is the arc HI, whose complement is FI; and since *by Theor.* 22 in the Triangle AGE right-angled in G, the Radius is to the Tangent of the angle E, as the Sine of the arc EG, or Sine complement of the angle ACD, to the Tangent of the arc AG, or Tangent complement of the side AC: and that likewise in the Triangle BIF right-angled

Plate 7. Fig. 58. in I, the Radius, is to the Tangent of the angle F, or E its equal, as the Sine of the arc FI, or Sine complement of the angle BCD, to the Tangent of the arc BI, or Tangent complement of the side BC; it follows that the Sine complement of the angle ACD, is to the Sine complement of the angle BCD, as the Tangent complement of the side AC, is to the Tangent complement of the side BC. *Which was to be demonstrated.*

THEOREM XXVIII.

In a Spherical Triangle, the Sines of the two Angles made by the perpendicular, are proportional to the Sine complements of the two Angles at the Base.

Fig. 58. I Say, that in the spherical Triangle ABC, whose base is AB, with respect to its perpendicular CD; the Sine of the angle ACD, is to the Sine of the angle BCD, as the Sine complement of the angle A, to the Sine complement of the angle B.

PREPARATION.

Let the Construction be like the preceding, describe from the two points A, B, as Poles, at a Quadrants distance, the arcs of a great Circle KL, MN, and produce to these two arcs, the three sides of the Triangle ABC, and again the arc EGIF, and you have the four Quadrants AK, AP, BM, BO: Wherefore *by Theor.* 3. the four angles K, P, M, O, will be right ones, and *by Theor.* 2. the arc KP, will be the measure of the angle A, and the arc MO the measure of the angle B.

DEMONSTRATION.

Since the point C is the Pole of the arc GI, the arc GH will be the measure of the angle ACD, *by Theor.* 2. and likewise the arc HI will be the measure of the angle BCD, and *by Theor.* 3. each of the two angles G, I, will be right, as well as the two K, M: Wherefore *by Theor.* 3. the point L will be the Pole of the arc AC, and the point N the Pole of the arc BC, so that the four arcs LK, LG, MN, IN, will be Quadrants; so that the arc LP is the complement of the arc PK, or of the angle A, and ON the complement of the arc OM, or of the angle B. Moreover since the arcs LG, EH, are Quadrants, and consequently equal to each other, if

if from each you ſubſtract the common part EG, there will remain the arc LE equal to the arc GH, or to the angle ACD. Likewiſe ſince the arcs IN, HF, are Quadrants, and conſequently equal to each other, if from each you ſubſtract the common part FI, there will remain the arc FN equal to the arc HI, or to the angle BCD. Laſtly. in the Triangle LPE, right-angled in P, the Radius, is to the Sine of the angle E, as the Sine of the Hypotenuſe LE, or of the angle ACD, to the Sine of the ſide LP, or Sine complement of the angle A, *by Theor.* 23. and likewiſe in the Triangle NOF, right-angled in O, the Radius, is to the Sine of the angle F, or E, its equal, as the Sine of the Hypotenuſe FN, or of the angle BCD, to the Sine of the ſide ON, or Sine complement of the angle B. From whence it is eaſy to conclude, that the Sine of the angle ACD, is to the Sine of the angle BCD, as the Sine complement of the angle A, is to the Sine complement of the angle B. *Which was to be demonſtrated.* Plate 6. Fig. 58.

THEOREM XXIX.

In a Spherical Triangle, the Sine complements of two Angles made by the perpendicular, are reciprocally as the Tangents of the two ſides.

I Say, that in the ſpherical Triangle ABC, whoſe baſe is AB, with reſpect to its perpendicular CD, the Sine complement of the angle ACD, is to the Sine complement of the angle BCD, as the Tangent of the ſide BC, to the Tangent of the ſide AC. Fig. 57.

DEMONSTRATION.

Since *by Theor.* 27. the Sine complement of the angle ACD, is to the Sine complement of the angle BCD, as the Tangent complement of the ſide AC, to the Tangent complement of the ſide BC: and that *by Prop.* 3. *Chap.* 2. *Book* 1. the Tangent complement of the ſide AC, is to the Tangent complement of the ſide BC, as the Tangent of the ſide BC to the Tangent of the ſide AC; it follows, that the Sine complement of the angle ACD, is to Sine complement of the angle BCD, as the Tangent of the ſide BC, to the Tangent of the ſide AC. *Which was to be demonſtrated.*

THEOREM XXX.

In a Spherical Triangle having two unequal Sides, if you take the third ſide for the baſe, and conſequently its oppoſite angle for the Vertical angle, as the Rectangle under the Sines of the two ſides, is to the Square of the Radius, ſo is the difference between the verſed Sine of the baſe, and the verſed Sine of the difference of the ſides, to the verſed Sine of the vertical angle.

Plate 6. Fig. 59. I Say, that if in the Triangle ABC, the two ſides AB, BC, are unequal, and you take the third ſide AC, for the baſe, ſo that the *Vertical Angle* be B, the Rectangle under the Sines of the two ſides AB, BC, has the ſame ratio to the Square of the Radius, as the difference between the Verſed Sine of the baſe AC, and the verſed Sine of the difference of the ſame two ſides AB, BC, to the verſed Sine of the Vertical angle B.

PREPARATION.

Produce one of the two ſides AB, BC, as BC, ſo as to have the whole Circle FCGD, whoſe Centre O repreſents that of the Sphere. Produce alſo the baſe AC, and the ſide AB, ſo as to have the Semi-circles BAE, CAD, whoſe Diameters are BE, CD, to which draw the perpendicular Diameters HI, FG, which will cut from the Quadrants BH, CF, the equal arcs BC, FH, as appears by ſubſtracting from the Quadrants BH, CF, the common part CH. Deſcribe from the points B, C, as Poles, thro' the ſame point A, the ſmall Semi-circle MAN, KAL, whoſe Diameter MN, KL, interſect here in point P, thro' which, and thro' the point A, draw the right line AP, which will be the common ſection of the Planes of the two Semicircles MAN, KAL, and ſince *by* 19. 11. it is perpendicular to the Plane of the Circle CBGD, becauſe this Plane paſſing thro' the Poles C, B, of the two Semi-circles KAL, MAN, *by Conſtr.* is their perpendicular, *by Theor.* 3. it will be the Sine of the arc AM, and MP its verſed Sine, with reſpect of the Radius MT, which is the Sine of the arc BM, or of the ſide AB, as the Radius KV, of the Circle KAL, is the Sine of the arc CK, or of the baſe AC: Draw from the point M, the right line MR perpendicular to the Diameter KL, and the right line MS perpendicular to the Diameter CD, which (MS) will be the Sine of the arc CM, or of the difference of the two arcs BM, BC, or of the two ſides AB, BC;

BC; and as CS is its versed Sine, and CV the versed Sine of the arc CK, or of the base AC, it follows that SV, or MR is the difference of the versed Sines of the base AC, and of the difference of the sides AB, BC. Again from the point H, to the Diameter FG, draw the perpendicular HQ, which will be the Sine of the arc FH, or of the side BC, and parallel to the line MR, since this line (MR) is perpendicular to the Diameter KL, which is parallel to the Diameter FG, because of the two equal arcs CK, CL, *by Constr.* so that the two right-angled Triangles HQO, MRP are equi-angular. Lastly, take on the Radius FO, the part FX equal to the versed Sine of the angle B, with respect to the Radius FO, and this versed Sine FX will have the same Ratio to its Radius FO, as the versed Sine MP of the same angle B, which is measur'd by the arc AM, *by Theor.* 2. to its Radius MT, as will be shewn in the first of the following Lemma's. Plate 6, Fig. 59.

DEMONSTRATION.

Since the Rectangle under the Sines HQ, MT, is to the Square of the Radius HO, in a Ratio compounded of those of the sides HQ, HO and MT, HO, *by* 23. 6. and that HQ is to HO as MR to MP, because of the equi-angled Triangles HQO, MRP, and MT to HO, as MP to FX, it follows, that the Ratio of the Rectangle under the Sines HQ, MT, to the Square of the Radius HO, is compounded of those of MR to MP, and of MP to FX; and as the Ratio compounded of these two last Ratio's, is equal to that of MR to FX, it follows that the Rectangle under the Sine HQ of the side BC, and the Sine MT, of the side AB, is to the Square of the Radius HO, as the difference MR, or SV, of the versed Sine CV of the base AC, and of the versed Sine CS of the difference CM of the two sides AB, BC, to the versed Sine FX of the vertical angle B. *Which was to be demonstrated.*

COROLLARY.

It follows from this Theorem, that *the Rectangle under the Sines of the two Sides, is to the Square of the Radius, as the difference of the Sine Complements of the Base and of the difference of the two Sides, is to the versed Sine of the vertical angle.* Since the difference of the versed Sines of the two arcs, or of the two angles, is equal to the difference of the Sine complement. From whence may be drawn an easy Method to find any angle of a spherical Triangle, whose three sides are known, by taking the side opposite to this angle for the Base.

 But

But to the end that this angle may be found by Logarithms, which are very convenient in the computation of spherical Triangles, another Theorem may be drawn from the preceding, wherein there is no versed Sine; which we shall do after having shewn the following two Lemma's.

LEMMA I.

In unequal Circles, the versed Sines of similar Arcs, or of equal angles, have the same Ratio to each other as the Radii of their Circles have.

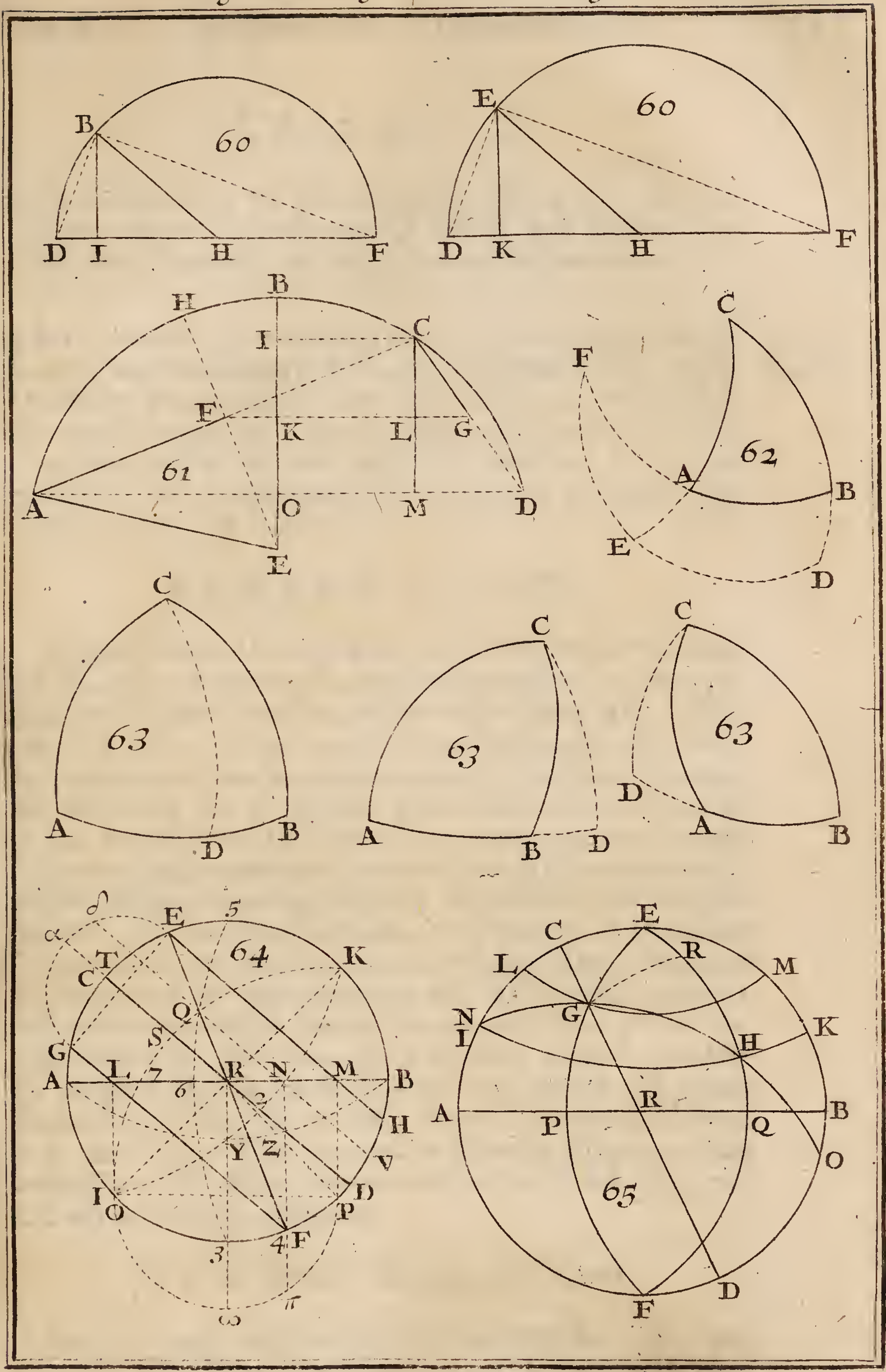
Plate 7. Fig. 60. I Say, that if the two arcs AB, DE, whose Centres are G, H, are similar, so that the angles AGB, DHE, which they measure, be equal to each other, their versed Sines AI, DK, terminated by their right Sines, BI, EK, are in the same Ratio as the Radii BG, EH.

DEMONSTRATION.

If you compleat the Semi-circles ABC, DEF, and draw the Chords AB, BC, DE, EF, it will appear *by* 31. 3. that the Triangles ABC, DEF, are right-angled in B, and in E, and *by* 32. 1. they are equi-angular, since the angles C, F, which are at the Circumference, being *by* 20. 3. the halves of the angles at the Centre AGB, DHE, which stand on the same arcs AB, DE, are equal to each other. From whence it follows *by* 8. 6. that the two right-angled Triangles AIB, DKE, are also equi-angular, and *by* 4. 6. that the versed Sine AI, is to the versed Sine DK, as the right Sine BI, to the right Sine EK, that is to say, as the Radius BG, to the Radius EH, because of the two similar right-angled Triangles BIG, EKH. *Which was to be demonstrated.*

Or since the two right-angled Triangles BIG, EKH, are equi-angular, it appears *by* 4. 6. that the Ratio of the Sine complement IG, to its Radius BG, or AG, is the same as that of the Sine complement KH, to its Radius EH or DH; wherefore *by division of Ratio's*, it will appear, that the versed Sine AI is to its Radius AG, as the versed Sine DK, to its Radius DH. *Which was to be demonstrated.*

LEMMA


60
B D I H F
60
E D K H F
61
H B I C F K L G A O M D E
62
C F A B E D
63
C A D B
63
C A B D
63
C D A B
64
δ α E 5 K T C Q S G A L 7 R N M B 6 2 H Y Z V I O D P 3 4 F π ω
65
E C R L M N G I K H A R B P Q O D F

LEMMA II.

As the Radius is to the Sine of half the Sum of two Arcs, or of two Angles, so is the Sine of half of their difference, to half the difference of the versed Sines of the same two Arcs.

I Say, that if of the two arcs AB, BC, whose common Centre is E, and whose Sum is ABC, the difference is CD, which is found by producing the Sum ABC to D, so that the arc BD is equal to the arc AB: the Radius AE, is the Sine AF of the half AH of the Sum ABC; as the Sine CG, is to the half CL of the difference IO of the versed Sines BO, BI, of the two arcs AB, BC. Plate 7. Fig. 61.

PREPARATION.

Join the Chords AC, CD, AD, and having divided the two first AC, CD, in two equal parts at the points F, G, draw the right-line FG, which will be parallel to the Chord AD, *by* 2.6. and the Radius EFH, which will cut at right-angles the Chord AC, and divide its arc in two equal parts, in the point H, so that AF will be the Sine of half the Sum ABC, and CG the Sine of half the difference CD, *by Def.* 16. Draw again from point C the line CM perpendicular to the Chord AD, which *by* 2.6. will be divided in two equal parts in the point L, by the right-line FG. If you draw the Radius EB, which will divide the Chord AD in two equal parts and at right-angles in the point O, because of the two equal arcs AB, BC *by Constr.* the part BO will be the versed Sine of the arc AB, since AO is the right Sine of it: and if you draw from the point C, the line CI perpendicular to the Radius EB, the part BI will be the versed Sine of the other arc BC, since CI is the right Sine of it, so that IO, or CM its equal, will be the difference of the versed Sines BO, BI, of the two arcs propos'd AB, BC, and CL will be half this difference.

DEMONSTRATION.

Since the angle AEF is half the arc ABC *by Constr.* and the angle D is also half the same arc ABC *by* 20. 3. these two angles will be equal to each other, and *by* 32. 1. the two right-angled Triangles AEF, CDM, will be equi-angular: Wherefore *by* 4. 6. the Ratio of the two sides AE, AF, will be equal to that of the two homologous ones CD, CM, or of their halves CG, CL. *Which was to be demonstrated.*

COROLLARY.

It follows from this Propofition, that *the Rectangle under the Radius and half the difference of the verfed Sines of two unequal arcs, is equal to the Rectangle under the Sine of half the Sum of thefe two arcs, and the Sine of half their difference:* For fince the four lines AE, AF, CG, CL are proportional, the rectangle under the extreams AE, CL will be equal to the Rectangle of the means AF, CG, *by* 16. 6.

Plate 7. Fig. 51.

THEOREM XXXI.

In a Spherical Triangle having two unequal Sides, the Rectangle under the Sines of thefe two Sides, is to the Square of the Radius, as the Rectangle under the Sine of half the Sum of the Bafe and the difference of the Sides, and the Sine of half the difference between the Bafe and the difference of the fame Sides, to the Square of the Sine of half the vertical Angle.

Plate 6. Fig. 59.

I Say, that in the fpherical Triangle ABC, if the two fides AB, BC are unequal, there is the fame Ratio of the Rectangle under the Sines of the two fides AB, BC, to the Square of the Radius, as of the Rectangle under the Sine of half the Sum of the bafe AC and the difference of the fides AB, BC, and the Sine of half the difference between the bafe AC and the difference of the fame fides AB, BC, to the fquare of the Sine of half the vertical angle B.

DEMONSTRATION.

Since *by Theor.* 30. thefe four Terms are proportional.

The Rectangle under the Sines of the two Sides AB, BC,
The Square of the Radius,
The difference between the verfed Sine of the Bafe AC, and the verfed Sine of the difference of the Sides AB, BC,
The verfed Sine of the vertical angle B.

If to the two laft Terms you give the Radius for the common height, it will appear that thefe four other Terms are proportional,

The Rectangle under the Sines of the two Sides AB, BC,
The Square of the Radius,

The

The Rectangle under the Radius and the difference between the versed Sine of the Base AC; and the versed Sine of the difference of the Sides AB BC, Plate 6. Fig. 59.

The Rectangle under the Radius and the versed Sine of the vertical angle B.

If inſtead of the two laſt Terms you take their halves, you will have theſe four proportional Terms.

The Rectangle under the Sines of the two Sides AB, BC,
The Square of the Radius.
The Rectangle under the Radius and half the differenee between the versed Sines of the Base AC, and the difference of the Sides AB, BC,
The Rectangle under half the Radius, and the versed Sine of the vertical angle B.

Laſtly, if inſtead of the third Term you take the Rectangle under the Sine of half the Sum of the baſe AC, and the difference of the ſides AB, BC, and the Sine of half the difference between the baſe AC, and the difference of the ſides AB, BC, which is equal to it, *by Lem.* 2. and in the room of the fourth Term, you put the ſquare of the Sine of half the vertical angle B, which is equal to it, *by Prop.* 16. *Chap.* 2. *Book* 1. you will have this laſt Analogy,

As the Rectangle under the Sines of the two Sides AB, BC,
To the Square of the Radius,
So the Rectangle under the Sine of half the Sum of the Base AC, and the difference of the Sides AB, BC, and the Sine of half the difference between the Base AC and the difference of the Sides AB, BC.
To the Square of the Sine of half the vertical angle B. Which was to be demonſtrated.

COROLLARY.

It follows from this Theorem, that in a ſcalene ſpherical Triangle, the three ſides being given, you may find any of the three angles, by means of the preceding Analogy, which may be rendred more eaſy, by conſidering that half the Sum of the baſe AC and the difference of the ſides AB, BC, is the ſame thing as the exceſs of half the Sum of the three ſides above the ſide BC, and that half the difference between the baſe AC, and the difference of the ſides AB, BC, is the ſame thing as the exceſs of half the Sum of the three ſides above the other ſide AB, which changes the preceding Analogy to this;

As

Plate 6. Fig. 59.

As the Rectangle under the Sines of the two ſides AB, BC,
To the Square of the Radius;
So is the Rectangle under the two exceſſes of half the Sum of the three Sides above each of the two Sides AB, BC,
To the Square of the Sine of half the vertical angle B.

Which may be eaſily reduc'd to theſe two,

As one of the two ſides AB, BC,
To the exceſs of half the Sum of the three Sides above one of the two AB, BC,
So is the exceſs of the ſame half above the other ſide,
To a fourth term.

As the other ſide,
To the fourth Term found;
So is the Radius,
To another fourth Term.

Which being multiplied by the Radius, the ſquare Root of the Product will be the Sine of half the vertical angle B, all this is too eaſily demonſtrated to ſpend any more words about it. Wherefore we ſhall finiſh this Chapter, and come to the Practice, by reaſonings drawn from the preceding Theorems.

CHAP. II.

Of the Calculation of Right-angled Spherical Triangles.

TO proceed methodically, we ſhall firſt find the Angles, and afterwards their Sides, and laſtly the Hypotenuſe, as ſhall be ſhewn in the following Problems.

PROBLEM I.

Two Sides being given, to find either of the two oblique Angles.

Plate 7. Fig. 62.

IF the two ſides AB, BC, of the ſpherical Triangle ABC right-angled in B, are given, you may find either of the oblique angles AC, for example A, by making *by Theor.* 22. this Analogy

As

As the Sine of the side AB, adjacent to the requir'd Angle A, Plate 7. Fig. 62.
To the Radius;
So is the Tangent of the other side BC,
To the Tangent of the Angle A.

If you wou'd have an Analogy where the first Term is Radius, to avoid Division, put instead of the two first Terms, namely the Sine of the side AB, and the Radius, the Radius and Co-secant of the side AB, which are in the same Ratio, *by Prop*, 2. *Chap*. 3. *Book* 1. and the preceding Analogy will be chang'd to this,

As the Radius,
To the Co-secant of the side AB;
So is the Tangent of the side BC,
To the Tangent of the Angle A.

Or put instead of the two last Terms, which are the Tangent of the side BC, and the Tangent of the angle A, the Co-tangent of the angle A, and the Co-tangent of the side BC, which are in the same Ratio, *by Prop*. 2. *Chap*. 2. *Book* 1. and then the first Analogy will be chang'd to this.

As the Radius,
To the Sine of the side AB;
So is the Co-tangent of the side BC,
To the Co-tangent of the Angle A.

It is evident *by Theor*. 10. that the angle A will be acute, if its opposite side BC be acute, and obtuse if obtuse.

PROBLEM II.

An Oblique Angle and the Side adjacent to this Angle being given, to find the other Oblique Angle.

If the oblique angle A, and its adjacent side AB, in the spherical Triangle ABC, right-angled in B, be known, the other oblique angle C may be found thus; Describe from this angle C, as Pole, at 90 degrees distant from it, the arc of a great Circle DEF, which cuts here the two sides AB, BC, and the Hypotenuse AC, in the points F, D, E, and make the Triangle AEF right-angled in E, where you know the oblique angle A, and the Hypotenuse AF, complement of the known side Fig. 62.

Plate 7. Fig. 62. ſide AB; wherefore you may find the ſide EF, the complement of the arc ED, or of the angle C by making *by Theor.* 23. this Analogy,

As the Radius.
To the Co-ſine of the ſide AB;
So is the ſine of the Angle A,
So the Co-ſine of the Angle C.

It is evident *by Theor.* 10. that if the given ſide AB is acute, its oppoſite angle C is acute; and obtuſe if the given ſide AB is obtuſe.

PROBLEM III.

An Oblique Angle, and the ſide oppoſite to this Angle, being given, to find the other Oblique Angle.

Fig. 62. IF the oblique angle C, and its oppoſite ſide AB, in the ſpherical Triangle ABC right-angled in B, be known, to find the other oblique A; Let the Conſtruction be like the preceding, and you'll have the other Triangle AEF right-angled in E, in which you know the ſide EF, complement of the arc DE, or of the given angle C, and the Hypotenuſe AF, complement of the given ſide AB. Wherefore you may there find the angle A, by making *by Theor.* 23. this Analogy,

As the Co-ſine of the ſide AB,
To the Radius;
So is the Co-ſine of the Angle C,
To the Sine of the Angle A.

To have an Analogy whoſe firſt Term is the Radius, which will render the Calculation more eaſy; put inſtead of the two firſt Terms, which are the Co-ſine of the ſide AB, and the Radius, the Radius, and the Secant of the ſide AB, which are in the ſame Ratio, *by Prop.* 2. *Chap.* 3. *Book* I. and the preceding Analogy will be chang'd to this,

As the Radius,
To the Secant of the ſide AB;
So is the Co-ſine of the Angle C,
To the Sine of the Angle A.

PRO-

PROBLEM IV.

The Hypotenuse and a Side being given, to find the Angle opposite to that Side.

IF the Hypotenuse AC, and the side AB, in the spherical Triangle ABC right-angled in B, be known, the angle C opposite to the given side AB may be found, by making *by Theor.* 23. this Analogy, Plate 7. Fig. 62.

As the Sine of the Hypotenuse AC,
To the Radius ;
So is the Sine of the side AB,
To the Sine of the Angle C.

To have an Analogy whose first Term is the Radius, which is more convenient for Practice ; put instead of the two first Terms, which are the Sine of the Hypotenuse AC, and the Radius, the Radius, and the Co-secant of the Hypotenuse AC, which are in the same Ratio, *by Prop.* 2. *Chap.* 3. *Book* 1. and the preceding Analogy will be chang'd to this,

As the Radius,
To the Co-secant of the Hypotenuse AC ;
So is the Sine of the side AB,
To the Sine of the Angle C.

It is evident *by Theor*, 10. that this angle C will be acute, if its opposite side AB be acute, and obtuse if it be obtuse.

PROBLEM V.

The Hypotenuse, and a Side being given, to find the Oblique Angle adjacent to that side.

IF the Hypotenuse AC, and the side BC, of the spherical Triangle ABC right-angled in B, be known, the oblique angle C, adjacent to the given side BC may be found, by making a Preparation like that in *Probl.* 2. whereby you'll have the Triangle AEF, right-angled in E, where the side AE, complement of the given Hypotenuse AC, and the angle F, or the arc BD complement of the given side BC are known ; wherefore you may there find the side EF complement of the arc ED, or of the angle C, by making *by Theor.* 22. This Analogy, Fig. 62.

As

Plate 7. Fig. 62.

As the Co-tangent of the ſide BC,
To the Radius;
So is the Co-tangent of the Hypotenuſe AC,
To the Co-ſine of the Angle C,

To have an Analogy whoſe firſt Term is the Radius, inſtead of the two firſt Terms, which are the Co-tangent of the ſide BC, and the Radius, put the Radius, and the Tangent of the ſide BC, which are in the ſame Ratio, *by Prop.* 2. *Chap.* 2. *Book* 1. and the preceding Analogy will be chang'd to this,

As the Radius,
To the Tangent of the ſide BC;
So is the Co-tangent of the Hypotenuſe AC,
To the Co-ſine of the Angle C.

It is evident *by Coroll.* 3. *Theor.* 11. that this angle C will be acute, if the Hypotenuſe AC, and the ſide BC, are of the ſame kind, and obtuſe if of different kind.

PROBLEM VI.

The Hypotenuſe, and an Oblique Angle being given, to find the other Oblique Angle.

Fig. 62. If the Hypotenuſe AC, and the oblique angle A, of the ſpherical Triangle ABC right-angled in B, be known, the other oblique angle C may be found, by making a Preperation like that in *Probl.* 2. ſo as to have the Triangle AEF right-angled in E, where beſides the oblique angle A, the ſide AE complement of the given Hypotenuſe AC, is known; wherefore you may there find the other ſide EF, complement of the arc ED, or of the angle C, by making *by Theor.* 22. this Analogy,

As the Radius,
To the Co-ſine of the Hypotenuſe AC;
So is the Tangent of the Angle A,
To the Co-tangent of the Angle C.

It is evident *by Coroll.* 3. *Theor.* 11. that this angle C will be of the ſame kind as the known angle A, if the Hypotenuſe AC be leſs than a Quadrant, and of a different kind, if it be greater than a Quadrant.

PRO-

PROBLEM VII.

The two oblique Angles being given, to find either of the two Sides.

IF the two oblique angles A, C, of the spherical Triangle ABC right-angled in B, be known, either of the two sides AB, BC, as AB, may be found by making *by Prob.* 2. this Analogy, Plate 7. Fig. 62.

As the Sine of the Oblique Angle A, adjacent to the side AB.
To the Radius;
So is the Co-sine of the other Oblique Angle C;
To the Co-sine of the side AB.

To have an Analogy whose first Term is the Radius; instead of the two first Terms, which are the Sine of the angle A, and the Radius, put the Radius, and the Co-secant of the angle A, which are in the same Ratio, *by Prop.* 2. *Chap.* 3. *Book* 1. and the preceding Analogy will be chang'd into this,

As the Radius,
To the Co-secant of the Angle A;
So is the Co-sine of the Angle C,
To the Co-sine of the side AB.

It is evident *by Theor.* 10. that this side AB will be acute, if its opposite angle B be acute, and obtuse if it be obtuse.

PROBLEM. VIII.

An Oblique Angle, and the Side adjacent to that Angle, being given, to find the side opposite to it.

IF the angle C, and the adjacent side BC, in the spherical Triangle ABC right-angled in B, be known, the other side AB may be found, by making *by Theor.* 22. this Analogy, Fig. 62.

As the Radius,
To the sine of the side BC;
So is the Tangent of the Angle C,
To the Tangent of the side AB.

It is evident *by Theor.* 10. that this side AB will be acute, if its oposite angle C be acute, and obtuse if it be obtuse.

PRO-

PROBLEM IX.

An Oblique Angle and the ſide oppoſite to that Angle being given, to find the ſide adjacent to it.

Plate 7. Fig. 62. IF the angle C, and its oppoſite ſide AB, in the Spherical Triangle ABC, right-angled in B, be known, the other ſide BC may be found, by making *by Theor.* 22. this Analogy,

As the Tangent of the Angle C,
To the Radius;
So is the Tangent of the ſide AB,
To the Sine of the ſide BC.

To have an Analogy whoſe firſt Term is the Radius: inſtead of the two firſt Terms, which are the Tangent of the angle C, and the Radius, put the Radius and the Co-tangent of the angle C, which are in the ſame Ratio *by Prop.* 2. *Chap.* 2. *Book* 1. and the preceding Analogy will be chang'd into this,

As the Radius,
To the Co-tangent of the Angle C;
So is the Tangent of the ſide AB,
To the Sine of the ſide BC.

PROBLEM X.

The Hypotenuſe and an Oblique Angle being given, to find the ſide oppoſite to that Angle.

Fig. 62. IF the Hypotenuſe AC, and the oblique angle A, in the Spherical Triangle ABC right-angled in B, be known, the ſide BC oppoſite to this angle may be found, by making *by Theor.* 23. this Analogy.

As the Radius.
To the Sine of the Hypotenuſe AC;
So the Sine of the Angle A,
To the Sine of the ſide BC.

It is evident by *Theor.* 10. that this ſide BC will be acute, if its oppoſite angle A is acute, and obtuſe, if it be obtuſe.

PRO-

PROBLEM XI.

The Hypotenuse, and an Oblique Angle being given, to find the side adjacent to that Angle.

IF the Hypotenuſe AC, and the oblique angle C, of the ſpherical Triangle ABC right-angled in B, be known, the ſide BC adjacent to this angle may be found, by making, *by Prob.* 5. this Analogy, Plate 7. Fig. 62.

As the Co-ſine of the Angle C,
To the Radius;
So is the Co-tangent of the Hypotenuſe AC,
To the Co-tangent of the ſide BC,

This Analogy was drawn from the firſt of *Probl.* 5. which we have revers'd; and by reverting the ſecond, you will have this other Analogy,

As the Co-tangent of the Hypotenuſe AC,
To the Radius,
So is the Co-ſine of the Angle C,
To the Tangent of the ſide BC;

If you wou'd change the firſt Analogy into another, which begins with the Radius, put inſtead of the two firſt Terms, which are the Co-ſine of the angle C, and the Radius, the Radius and the Secant of the angle C, which are in the ſame Ratio, *by Prop.* 2. *Chap.* 3. *Book* 1. and then you will have this other Analogy,

As the Radius.
To the Secant of the Angle C;
So is the Co-tangent of the Hypotenuſe AC,
To the Co-tangent of the ſide BC.

But as the Logarithms of Secants are not in our Tables, if you wou'd work by Logarithms, and have in the firſt Term the Radius, change the ſecond Analogy, by putting inſtead of its two firſt Terms, which are the Co-tangent of the Hypotenuſe AC, and the Radius, the Radius and the Tangent of the Hypotenuſe AC, which are in the ſame Ratio, *by Prop.* 2. *Chap.* 2. *Book* 1. and then you will have this other Analogy.

Plate 7. Fig. 62.

As the Radius.
To the Tangent of the Hypotenuſe AC;
So is the Co-ſine of the Angle C,
To the Tangent of the ſide BC.

It is evident *by Theor.* 10. and *by Coroll.* 2. *Theor.* 11. that this ſide BC will be acute, if the Hypotenuſe AC, and the given angle C, are each acute, ſince *by Coroll.* 2 *Theor.* 11. the angle A will be acute, and *by Theor.* 10. its oppoſite ſide BC is alſo acute. The ſame ſide BC will be obtuſe, if the Hypotenuſe AC be greater than a Quadrant, and the given angle C acute, or if the Hypotenuſe AC be leſs than a Quadrant, and the angle C obtuſe, ſince in theſe two Caſes the other angle A will be acute, *by Coroll.* 2. *Theor.* 11. and conſequently its oppoſite ſide BC obtuſe, *by Theor.* 10.

PROBLEM XII.

The Hypotenuſe, and a Side being given, to find the other Side.

Fig. 62. IF the Hypotenuſe AC, and the ſide AB, of the Spherical Triangle ABC right-angled in B, be known, the other ſide BC may be found, by a Preparation like that in *Probl.* 2. whereby you have the Triangle AEF right-angled in E, where the ſide AE the complement of the given Hypotenuſe AC, and the Hypoteunſe AF the complement of the given ſide *AB*, are known; wherefore the angle F, or the Arc BD, the complement of the ſide BC may be found, by making *by Theor.* 23. this Analogy,

As the Co-ſine of the Side AB,
To the Radius,
So is the Co-ſine of the Hypotenuſe AC,
To the Co-ſine of the Side BC.

Or by making *by Prop.* 2. *Chap.* 3. *Book* 1. this other Analogy,

As the Radius,
To the Secant of the Side AB;
So is the Co-ſine of the Hypotenuſe AC,
To the Co-ſine of the Side BC.

It is evident *by Coroll.* 3 *Theor.* 11. that this ſide BC will be acute, when the Hypotenuſe AC, and the ſide AB, which are

are known, are of the ſame affection, and obtuſe, when they are of a different affection.

PROBLEM XIII.

The two Oblique Angles being given, to find the Hypotenuſe.

IF each of the two oblique angles A, C, of the Spherical Triangle ABC, right-angled in B, be known, the Hypotenuſe AC may be found, by making *by Probl.* 6. this Analogy. Plate 7. Fig. 62.

As the Tangent of the Angle A,
To the Radius;
So is the Co-tangent of the Angle C,
To the Co-ſine of the Hypotenuſe AC.

To have an Analogy which begins with the Radius, put inſtead of the two firſt Terms, which are the Tangent of the angle A and the Radius, the Radius and the Co-tangent of the angle A, which are in the ſame Ratio *by Prop.* 2. *Chap.* 2. *Book* 1. and the preceding Analogy will be chang'd into this,

As the Radius,
To the Co-tangent of the Angle A;
So is the Co-tangent of the Angle C,
To the Co-ſine of the Hypotenuſe AC.

It is evident *by Coroll.* 1. *Theor.* 11. that the Hypotenuſe AC, will be leſs than a Quadrant, if the two given angles are of the ſame affection; and that if they are of different affection, they will be greater than a Quadrant.

PROBLEM XIV.

An oblique Angle, and its oppoſite Side being given, to find the Hypotenuſe.

IF the oblique angle A, and its oppoſite ſide BC, of the Spherical Triangle ABC, right-angled in B, be known, the Hypotenuſe AC may be found, by making *by Theor.* 23. this Analogy, Fig. 62.

Plate 7. Fig. 62.

As the Sine of the Angle A,
To the Radius;
So is the Sine of the Side BC,
To the Sine of the Hypotenuse AC.

To have an Analogy whose first Term is the Radius, you must put instead of the two first Terms, which are the Sine of the angle A and the Radius, the Radius and the complement Secant of the angle A, which are in the same Ratio, *by Prop.* 2. *Chap.* 3. *Book* 1. and the preceding Analogy will be chang'd into this,

As the Radius,
To the Secant of the Angle A;
So is the Sine of the Sides BC,
To the Sine of the Hypotenuse AC.

PROBLEM XV.

An Oblique Angle, and its adjacent Side being given, to find the Hypotenuse.

Fig. 62. IF the angle C, and its adjacent side BC, of the Spherical Triangle ABC right-angled in B, be known, the Hypotenuse AC may be found, by making *by Probl.* 11. this Analogy.

As the Radius,
To the Co-sine of the Angle C;
So is the Co-tangent of the Side BC,
To the Co-tangent of the Hypotenuse AC.

It is evident *by Theor.* 11. that the Hypotenuse AC will be less than a Quadrant, when the given angle C, and its adjacent side BC, are both acute, or both obtuse, because in these two Cases, the two sides AB, BC, will be also both acute, or both obtuse, *by Theor.* 10. But the Hypotenuse AC will be greater than a Quadrant, when the given angle C, and the adjacent side BC, the one is acute, and the other obtuse, because of the two sides AB, BC, the one is acute, and the other obtuse, *by Theor.* 10.

PRO-

PROBLEM XVI.

The two Legs being given, to find the Hypotenuſe.

IF each of the two ſides AB, BC, of the Spherical Triangle ABC right-angled in B, be known, the Hypotenuſe AC may be found, by making *by Prob.* 12. this Analogy, Plate 7. Fig. 62.

As the Radius,
To the Co-ſine of the ſide AB;
So is the Co-ſine of the Side BC,
To the Co-ſine of the Hypotenuſe AC.

It is evident *by Theor.* 11. that the Hypotenuſe AC will be leſs than a Quadrant, if the two given ſides AB, BC, be both acute, or both obtuſe, and it will be greater than a Quadrant, if one of the two given ſides AB, BC be acute, and the other obtuſe.

CHAP. III.

Of the Calculation of Oblique-angled Spherical Triangles.

WE ſhall alſo begin with the Computation of Angles, and proceed afterwards to that of the Sides, by reducing the Triangle propos'd into two right-angled Triangles, by a perpendicular, as you'll find in the following Problems. Fig. 63.

PROBLEM I.

Two Angles, and a Side oppoſite to one of theſe two Angles being given, to find the third Angle.

IF the two angles A, B, and the ſide BC oppoſite to this angle A, be known, the third angle C may be found, by letting fall from this angle C, on its oppoſite ſide AB, the Perpendicular CD, which will fall within the Triangle ABC, when the two angles A, B, are of the ſame kind, but without when of different kind, and then *by Theor.* 12. *by Probl.* 6. *Chap.* 2. the Analogy is

Plate 7. Fig. 63.

As the Radius,
To the Co-sine of the Sides BC;
So is the Tangent of the Angle B,
To the Co-tangent of the Angle BCD.

This angle BCD being alſo known, the angle ACD, will be found, by making, *by Theor.* 28. this other Analogy,

As the Co-sine of the Angle B,
To the Co-sine of the Angle A;
So is the Sine of the Angle BCD,
To the Sine of the Angle ACD.

The angles ACD, BCD, being alſo known, their Sum will give the angle C requir'd, when the perpendicular CD falls within the Triangle, and their difference will give this angle C, when the perpendicular falls without.

PROBLEM II.

Two Angles, and the Side included being given, to find the third Angle.

IF the two angles B, C, and the included ſide BC, of the Spherical Triangle ABC, be known, the third angle A, may be found, by drawing from one of the two given angles B, C, as from C, to its oppoſite ſide AB, the perpendicular CD, and making *by Probl.* 6. *Chap.* 2, this firſt Analogy,

As the Radius,
To the Co-sine of the ſide BC;
So is the Tangent of the Angle B,
To the Co-tangent of the Angle BCD.

Which being ſubſtracted from the given angle ACB, when the perpendicular CD falls within the Triangle ABC, you will have the angle ACD, which is equal to the Sum of the two preceding ones, when the perpendicular CD falls without the Triangle ABC, towards the given ſide BC, which will happen *by Theor.* 12. when the angle B is obtuſe, and the angle A acute. Theſe two angles ACD, BCD, being alſo known, you will find the angle A by making *by Theor.* 28. this Analogy,

As

As the Sine of the Angle BCD,
To the Sine of the Angle ACD;
So is the Co-sine of the Angle B,
To the Co-sine of the Angle A. Plate 7. Fig. 63.

Which *by Theor.* 14. will be obtuse, when the two given angles B, C, and the included side BC, are obtuse.

PROBLEM III.

Two Sides being given, and an Angle opposite to one of them, to find the Angle comprehended by these two Sides.

If the two sides AC, BC, and the angle B opposite to the given side AC, of the spherical Triangle ABC, be known, the included angle C may be found, by drawing from this angle C, to its opposite side AB, the perpendicular CD, and making first *by Probl.* 6. *Chap.* 2. this Analogy,

As the Radius,
To the Co-sine of the side BC;
So is the Tangent of the Angle B,
To the Co-tangent of the Angle BCD.

This angle BCD being also known, you will find the other angle ACD, by making *by Theor.* 29. this second Analogy,

As the Tangent of the Side AC,
To the Tangent of the Side BC;
So is the Co-sine of the Angle BCD,
To the Co-sine of the Angle ACD.

The two vertical angles BCD, ACD, being also given, the required angle ACB will be also known, since it is equal to the Sum of the two preceding ones, when the perpendicular CD falls within the Triangle ABC, and to their difference, when it falls without.

PROBLEM IV.

Two Sides, and the Angle comprehended by them, being given, to find either of the other Angles.

Plate 7. Fig. 63. IF the two ſides AB, BC, and the included angle B, be known, and you wou'd find either of the two other angles A, C, as A; draw from the other angle C, on its oppoſite ſide AB, the perpendicular CD, which will divide this baſe AB into two Segments AD, BD; the laſt whereof BD will be found, by making *by Probl.* 11. *Chap.* 2. this Analogy,

As the Radius,
To the Co-ſine of the Angle B;
So is the Tangent of the Side BC;
To the Tangent of the Segment BD.

Which being known, the other Segment AD will be alſo known, ſince the baſe AB is known; and then you may find the angle A, by making *by Theor.* 25. this Analogy,

As the Sine of the Segment AD,
To the Sine of the Segment BD;
So is the Tangent of the Angle B,
To the Tangent of the Angle A.

PROBLEM V.

Two Sides, and an Angle oppoſite to one of them, being given, to find the Angle oppoſite to the other Side.

IF the two ſides AC, BC, and the angle B oppoſite to the given ſide AC, of the Spherical Triangle ABC, be known, the angle A oppoſite to the other given ſide BC, may be found, by making *by Theor.* 24. this Analogy,

As the Sine of the Side AC,
To the Sine of its oppoſite Angle B;
So is the Sine of the Side BC,
To the Sine of its oppoſite Angle A.

PRO-

PROBLEM VI.

The three Sides being given, to find any of the three Angles.

TO find, for example, the angle A, of the ſpherical Triangle ABC, whoſe three ſides are known; deſcribe from one of the two other angles B, C, as from C, at 90 degrees diſtance, an arc of a great Circle DE, which cuts here the three ſides in the points D, E, F, and firſt make this Analogy, Plate 7. Fig. 63.

As the difference of the Co-ſines of the Sides AC, BC,
To the Sum of the ſame Co-ſines;
So the Tangent of half the Side AB,
To the Tangent of half the Sum of the arcs BF, AF.

If the angle A be acute, and the ſide AC greater than the ſide BC, the Sum of the two arcs BF, AF, will be leſs than a Semi-circle, as is eaſy to be demonſtrated, and thus the half of this Sum will be ſuch as may be found in the Tables. But if the angle A be obtuſe, which may be known *by Theor.* 16. and *by Theor.* 17. or if this angle A be acute, and the ſide AC leſs than the ſide BC, in one of theſe two caſes the Sum of the two arcs BF, A F, will be greater than a Semi-circle, as is alſo eaſy to be demonſtrated. For then you muſt ſubſtract from 180 degrees, the complement of the degrees and minutes, which was found in the preceding Analogy, and the remainder will be half the Sum of the arcs BF, AF, which Sum being alſo known, if you ſubtract from it the given ſide AB, half the remainder will be the arc AF, which is the Hypotenuſe of the Triangle AEF, right-angled in E, where you'll find likewiſe the ſide AE the complement of the given ſide AC. Wherefore to find the angle A, make *by Probl.* 5. *Chap.* 2. this Analogy,

As the Radius,
To the Co-tangent of the Side AC;
So is the Co-tangent of the arc AF,
To the Co-ſine of the Angle A,

Demonſtration of the firſt Analogy.

The Demonſtration of the preceding Analogy is evident *by Probl.* 5. *Chap.* 2. but the firſt Analogy wants a Demonſtration, which may be thus.

Since

Plate 7. Fig. 62. Since in the Triangle BDF, right-angled in D, the Radius, is to the Sine of the angle F, as the Sine of the Hypotenuse BF, to the Sine of the side BD, *by Theor.* 23. and likewise in the Triangle AEF right-angled in E, the Radius, is to the Sine of the same angle F; as the Sine of the Hypotenuse AF, to the Sine of the side AE: It follows that the Sine of the arc BF, is to the Sine of the arc AF, as the Sine of the arc BD, complement of the side BC, to the Sine of the arc AE, complement of the side AC. Wherefore *by compounding of Ratio's*, it will appear, that the Sum of the Sines of the arcs AF, BF, is to the Sine of the arc AF, as the Sum of the Sine of the arcs AE, BD, to the Sine of the arc AE: and *by Division of the same Ratio*, it will appear that the difference of the Sines of the arcs AF,BF, is to the Sine of the arc AF, as the difference of the Sines of the arcs AE, BD, to the Sine of the arc AE, and *ex æquo*, the Sum of the Sines of the arcs AE, BD, is to the difference of the same Sines, as the Sum of the sines of the arcs AF, BF, to the difference of the same Sines: and lastly by putting instead of the Sum and of the difference of the Sines of the arcs AF, BF, the Tangent of half the Sum and of half the difference AB, of the same arcs AF, BF, which are in the same Ratio, *by Theor.* 21. it will appear that the difference of the Co-sines of the sides AC, BC, is to the Sum of the same Co-sines, as the Tangent of half the side AB, to the Tangent of half the Sum of the arcs AF, BF. *Which was to be demonstrated.*

SCHOLIUM.

This Problem may be resolv'd otherwise and more easily by one single Analogy, which is drawn from *Theor.* 31. namely by substracting from half the Sum of the three given sides, each of the two sides AB, AC, which comprehends the angle A requir'd, and you'll have two excesses, and by making this Analogy,

As the Rectangle under the Sines of the two Sides AB, AC,
which comprehend the required angle A,
To the Square of the Radius;
So is the Rectangle under the two Excesses,
To the Square of the Sine of half the Angle A.

If then you take the Square Root of this fourth proportional, you will have the Sine of half the angle A, which consequently will be known.

It is evident, that when you wou'd work by Logarithms, which here shortens the operation very much, add to the Sum of

of the Logarithms of the two exceſſes, double the Logarithm of the Radius, and ſubſtract from the Sum, the Sum of the Logarithms of the Sines of the two ſides AB, AC, which comhends the angle A requir'd, and half the remainder will be the Logarithm Sine of half the angle A. Plate 7. Fig. 62.

PROBLEM VII.

The three Angles being given, to find any of the three Sides.

TO find, for example, the ſide AB of the ſpherical Triangle ABC, whoſe three angles are known; draw the perpendicular CD, on this ſide AB, from its oppoſite angle C, and make this firſt Analogy, which ſuppoſes that the perpendicular CD, falls within the Triangle ABC. Fig. 63.

As the Sum of the Co-ſines of the two Angles A, B, including the Side required AB,
To the difference of the ſame Sines;
So is the Tangent of half the third Angle C,
To the Tangent of half the difference of the two Angles ACD, BCD.

This Analogy may be chang'd into the following one, when the perpendicular CD falls without the Triangle ABC.

As the difference of the Co-ſines of the two angles A, B,
To the Sum of the ſame Sines;
So is the Tangent of half the third angle C,
To the Tangent of half the Sum of the two Angles ACD, BCD,

When the perpendicular CD falls within the Triangle ABC, half the difference of the two vertical angles ACD, BCD, will be known; and as their Sum, namely the whole angle C, is alſo known, if you add to, and ſubſtract from, half this known angle C, the found half difference, you will have the greateſt, and leaſt of the vertical angles ACD, BCD. But when the perpendicular CD falls without the Triangle ABC, half the Sum of the two vertical angles ACD, BCD, being known, if you add to it, and ſubſtract from it, half their difference, or half the angle ACB, which is known, you will have likewiſe the greateſt, and leaſt of the two vertical angles ACD, BCD, which being alſo known, you may find *by Prop.* 13. *Chap.* 2. in each of the two right-angled Triangles

Plate 7. Fig. 63. angles ADC, BDC, the ſides AC, BC, and *by Prob. 7. Chap.2.* the Segments AB, BD, and conſequently the ſide AB, requir'd.

Demonſtration of the firſt Analogy.

Since by *Theor.* 28. the Sine of the angle BCD, is to the Sine of the angle ACD, as the Co-ſine of the angle B, to the Co-ſine of the angle A, it will appear as in the preceding Problem, that the Sum of the Co-ſines of the two angles A, B, is to the difference of the ſame Sines, as the Sum of the Sines of the two angles ACD, BCD, to the difference of the ſame Sines: and if, inſtead of the two laſt Terms, you put the Tangents of half the Sum, and difference of the two angles ACD, BCD, which are in the ſame Ratio, *by Theor.* 21. it will appear, that the Sum of the Co-ſines of the two angles A, B, is to the difference of the ſame Sines, as the Tangent of half the Sum of the two angles ACD, BCD, that is to ſay, of half the third angle C, to the Tangent of half the difference of the ſame angles ACD, BCD. *Which was to be demonſtrated.*

SCHOLIUM.

Plate 5. Fig. 54. This Problem may be reſolv'd otherwiſe, and eaſier, by ſuppoſing *by Theor.* 20. inſtead of the Triangle ABC, another Triangle, as DEF, wherein each ſide is the remainder to 180 degrees of each oppoſite angle of the propos'd Triangle ABC, and reciprocally each angle thereof is the remainder to a Semi-circle of each oppoſite ſide of the ſame Triangle ABC. For ſince the angles of the Triangle ABC are ſuppos'd known, the ſides of the Triangle DEF, will be alſo known; by which means you may, by the preceding Problem, find the angles D, E, F, and conſequently the ſides of the propos'd Triangle ABC, by giving the remainder to 180 degrees of the angle D, to the oppoſite ſide BC: the remainder to 180 degrees of the angle E, to the oppoſite ſide AC; and the remainder to 180 degrees of the angle F to the oppoſite ſide AB.

PRO-

PROBLEM. VIII.

Two Angles and the Side opposite to one of them being given, to find the Side included by these Angles.

IF the two angles A, B, and the side BC opposite to the given angle A, of the spherical Triangle ABC, be known, the included side AB, may be found, by drawing from its opposite angle C, the perpendicular CD, which will divide this base AB, into two Segments AD, BD, the last BD may first be found by making *by Prob.* 11. *Chap.* 2. this Analogy, Plate 7. Fig. 63.

As the Radius,
To the Co-sine of the Angle B;
So is the Tangent of the Side BC,
To the Tangent of the Segment BD.

To find the Segment AD, make *by Theor.* 25. this other Analogy,

As the Tangent of the Angle A,
To the Tangent of the Angle B;
So is the Sine of the Segment BD,
To the Sine of the Segment AD.

It is evident, that the side AD required, is equal to the Sum of the two Segments AD, BD, when the perpendicular CD falls within the Triangle ABC, and is equal to their difference when the perpendicular falls without.

PROBLEM IX.

Two Angles and the Side included by these Angles, being given, to find either of the other Sides.

IF the two angles B, C, and the included side BC, be known, either of the two other sides AB, AC, as AC, may be found, by drawing on the other side AB, from its opposite angle C, the perpendicular CD, and making *by Prob.* 6. *Chap.* 2. this Analogy, Fig. 63.

As the Radius,
To the Co sine of the Side BC;
So is the Tangent of the Angle B.
To the Co-tangent of the Angle BCD.

This

Plate 7. Fig. 63. This angle BCD being known, the angle ACD will be also known, and then make *by Theor.* 27. this Analogy,

As the Co-ſine of the Angle BCD,
To the Co-ſine of the angle ACD;
So is the Co-tangent of the Side BC,
To the Co-tangent of the ſide AC.

PROBLEM X.

Two Angles, and the Side oppoſite to one of them, being given, to find the Side oppoſite to the other.

IF the two angles A, B, and the ſide BC, oppoſite to the given angle A, of the Triangle ABC, be known, the ſide AC oppoſite to the other given angle B, may be found, by making *by Theor.* 24. this Analogy,

As the Sine of the Angle A,
To the Sine of its oppoſite Side BC;
So the Sine of the Angle B,
To the Sine of its oppoſite Side AC.

PROBLEM XI.

Two Sides, and the Angle oppoſite to one of them, being given, to find the third Side.

IF the two ſides AC, BC, and the angle B, oppoſite to the given ſide AC, of the Triangle ABC, be known, the third ſide AB, may be found, by drawing from its oppoſite angle C, the perpendicular CD, which will divide it into two Segments AD, BD, the laſt BD will be found firſt by making *by Prob.* 11. *Chap.* 2. this Analogy,

As the Radius,
To the Co-ſine of the Angle B;
So is the Tangent of the Side BC,
To the Tangent of the Segments BD.

To find the other Segment AD, make *by Theor.* 26. this Analogy.

As the Co-ſine of the Side BC,
To the Co-ſine of the ſide AC;
So the Co ſine of the Segment BD,
To the Co-ſine of the Segment AD.

The

The Segments AD, BD, being known, the side AB will be also known, since it is equal to the Sum of the two Segments AD, BD, when the perpendicular CD falls within the Triangle ABC, and to their difference, when the perpendicular falls without. Plate 7. Fig. 63.

PROBLEM XII.

Two Sides, and the Angle which they comprehend being given, to find the third Side.

IF the two sides AB, BC, and the included angle B, of the Triangle ABC, be known, the third side may be found by drawing on one of the two given sides AB, BC, as AB, from its opposite angle C, the perpendicular CD, and by making first *by Probl.* 11. *Chap.* 2. this Analogy,

As the Radius,
To the Co-sine of the Angle B;
So the Tangent of the Side BC,
To the Tangent of the Segment BD.

Which being known, the other Segment AD will be also known, then find the side AC, by making *by Theor.* 26. this Analogy,

As the Co-sine of the Segment BD,
To the Co-sine of the Segment AD;
So the Co-sine of the Side BC,
To the Co-sine of the Side AC.

CHAP. IV.

ASTRONOMICAL QUESTIONS.

HAVING shewn the usefulness of the preceding Problems, that relate to right-lin'd Triangles, in our Practical Geometry; now to apply those Problems, that relate to Spherical Triangles, we shall add here some Astronomical Questions, which will serve as Instances, how many others may be resolv'd by the application of those Problems to the Circles of the Sphere.

QUE-

QUESTION I.

The Obliquity of the Ecliptic, and the Distance of the Sun from the next Equinox being given, to find its Declination.

Plate 7. Fig. 63. I Suppose that the Solstitial Colure coincides with the Meridian, so that these two Circles be represented by the single one AEKB, passing thro' the two Poles of the World K, I. If AB be the Horison, and CD the Equator, the arc BK, or the angle BRK, will be the *height of the Pole*, and the arc AC or the angle ARC, will be the *Elevation of the Equator*, which is equal to the complement of the Elevation of the Pole. If EF be the Ecliptic, the two points E, F, where it cuts the Colure, will be the *Solstitial points of* ♋ and of ♑, thro' which the Tropies EH, FG pass, which shew on the Horison AB, the greatest East or West *Amplitudes* of Summer and Winter, RM, RL; and the point R, where it cuts the Equator CD, will represent the two *Equinoctial points* of ♈, and of ♎. Lastly, the angle CRE, which it makes with the Equator CD, or the arc CE, is what we call the *Obliquity of the Ecliptic*, or *greatest Declination of the Sun*, which is at present about 23° 29′.

If we suppose that the Sun is at the point Q of the Ecliptic, so that its Parallel be TV, and its *Hour-circle* KQI, its *Declination* will be the arc CT, namely the distance of its parallel from the Equator, which is also measur'd by the arc SQ of the Hour-circle terminated by the Place of the Sun, and by the Equator: and its *Distance from the next Equinox* will be QR, namely the Arc of the Ecliptic included between the Place Q of the Sun, and the next Æquinoctial point R.

Since in the Triangle QRS, right-angled in S, the oblique angle QRS, or the greatest Declination of the Sun, and the Hypotenuse QR, or the distance of the Sun from the next Equinox, are known, its Declination QS, may be found, by making *by Prob.* 10. *Chap.* 2. this Analogy,

As the Radius,
To the Sine of the Distance of the Sun from the next Equinox;
So is the Sine of the greatest Declination of the Sun,
To the Sine of its present Declination.

QUESTION II.

The Obliquity of the Ecliptic, and the Declination of the Sun, being given, to find the Sun's place.

IF in the ſame right-angled Triangle RSQ, beſides the right-angle S, the angle QRS, or the greateſt obliquity of the Ecliptic, and the Declination of the Sun QS, be known, the *Sun's Place*, or its diſtance QR from the next Equinox, may be found, by making, *by Probl.* 14. *Chap.* 2. this Analogy, Plate 7. Fig. 64.

As the Sine of the Sun's greateſt Declination,
To the Sine of it's preſent Declination;
So is the Radius;
To the Sine of the diſtance of the Sun from the next Equinox.

QUESTION III.

The greateſt Declination of the Sun, and its Diſtance from the next Equinox, being given, to find its Right Aſcenſion.

IF in the ſame right-angled Triangle QRS, beſides the right-angle S, the angle QRS, or the greateſt Declination of the Sun, and its Diſtance QR, from the next Equinox, be given, its *Right Aſcenſion*, or the arc RS of the Equator intercepted between the Sun's Hour Circle, and the Equinoctial Point, may be found, by making *by Probl.* 11. *Chap.* 2. this Analogy.

As the Radius,
To the Co-ſine of the Sun's greateſt Declination;
So is the Tangent of the diſtance of the Sun from the next Equinox,
To the Tangent of the Sun's Right Aſcenſion.

QUESTION IV.

The Elevation of the Pole, and the Declination of the Sun, being given; to find its Eaſt or Weſt Amplitude.

WE call by the Name of *Eaſt Amplitude of the Sun*, the arc of the Horizon RN, intercepted between point N, where the Sun riſes, and the *true Eaſt point* R, or that

Q *Point*

Plate 7. Fig. 64. *Point of the Equinoctial*, where the Horizon AB is cut by the Equator CD, towards the East: and by the Name of *West Amplitude of the Sun*, I mean the arc of the Horizon, intercepted between the Point where the Sun sets, and the *true West Point*, or that *Point of the Equinox*, where the Horizon is cut by the Equator towards the West.

To find the East Amplitude RN; let the Hour-circle KN, pass thro' the Poles of the World K I, and thro' the Point N, of the Sun's rising, which *by Theor.* 23. will cut the Equator CD at right-angles in some point, as 2, so that the arc 2 N will be the Declination of the Sun, and as 2 RN is the complement of the Elevation of the Pole, the Amplitude RN may be found in the right-angled Triangle R2N, by making *by Prob.* 14. *Chap.* 2. this Analogy,

As the Co-sine of the Elevation of the Pole,
To the Sine of the Sun's Declination;
So is the Radius,
To the Sine of the East Amplitude.

QUESTION V.

The greatest Amplitude of the Sun, and its Distance from the next Equinox, being given, to find the Amplitude answerable to that Distance.

SInce by the Principles of the Orthographical Projection of the Sphere, when you have the greatest Declination of the Sun CG or CE, you describe about the line GE, the Semi-circle GαE, on which take the arc $\alpha\delta$ equal to the given distance of the Sun from the next Equinox, draw thro' the point δ, the line δV parallel to the line αD, which represents the Equator, and so you have on the Ecliptic EF, the place of the Sun in Q, and its Declination CT or QS: Likewise when you have the greatest Amplitude 3 O or 3 P, terminated by the three lines LO, R3, MP, perpendicular to the Diameter AB, which represents the Horizon, describe about the line OP, the Semicircle OωP, on which take the arc $\omega\pi$ equal to the given distance of the Sun from the next Equinox, draw thro' the point π, the right line πN perpendicular to the Diameter AB, and so you have on the line RP, which represents the Ecliptic, the place of the Sun in Z, and its Amplitude 3, 4, or the arc YZ; it follows, that this arc YZ, or Amplitude, may be found in the Triangle RYZ right-angled in Z, where you find the angle YRZ, or the greatest Amplitude, and the Hypotenuse RY, which represent the

the given diſtance of the Sun from the next Equinox, namely by making *by Probl.* 6. *Chap.* 2. this Analogy, Plate 7. Fig. 64.

As the Radius,
To the Sine of the diſtance of the Sun from the next Equinox;
So is the Sine of the greateſt Amplitude,
To the Sine of the Amplitude requir'd.

QUESTION VI.

The Declination of the Sun, and the Elevation of the Pole, being given, to find the Aſcenſional difference.

WE call by the Name of *Aſcenſional difference,* the arc of the Equator intercepted between the Hour-circle of ſix, and the Sun's Hour-Circle, when it riſes or ſets: as R 2, if the Sun riſes or ſets in N, the Axis of the World IK, repreſenting in this Projection, the Hour-circle of ſix. This arc R2 may be found in the Triangle R2N right-angled in 2, where the angle 2 RN, the complement of the height of the Pole, and the arc 2 N, or the Declination of the Sun are known, namely by making *by Prob.* 9. *Chap.* 2. this Analogy,

As the Radius,
To the Tangent of the Declination of the Sun;
So is the Tangent of the Elevation of the Pole,
To the Sine of the Aſcenſional difference.

It is evident that if you reduce into time the Aſcenſional difference found, by taking an Hour for 15 degrees, you will have the time in which the Sun riſes or ſets, and conſequently the Hour of riſing or ſetting of the Sun, whoſe double will give the length of the Night or Day.

QUESTION VII.

The Elevation of the Pole, and the Hour of Riſing or Setting of the Sun, being given, to find its Declination.

IF you ſubſtract from ſix Hours, the given Hour of the Sun's riſing or ſetting, you will have the Aſcenſional difference R 2, whoſe complement 2 D is the difference of the Sun from the Meridian, which is commonly call'd *Horary diſtance,* which being known, with the angle 2 RN, or the

Plate 7. Fig. 64. complement of the Elevation of the Pole, you may find the Declination 2 N, in the right-angled Triangle R2N, by by making *by Prob.* 8. *Chap.* 2. this Analogy,

As the Radius,
To the Co-sine of the Horary Distance ;
So is the Co-tangent of the height of the Pole,
To the Tangent of the Declination.

This Question is very useful in *Dialling*, when one has occasion to know how much the Sun declines from the Equator, when it rises or sets at a propos'd Hour, to be able to trace upon a Plan the lines of the *Babilonic* or *Italic* Hours, and also those of the *Jewish* or *Antique* Hours.

QUESTION VIII.

The Height of the Pole, and the Horary Distance, being given, to find the Arc of the Horizon intercepted between the Meridian and the Sun's Horary Circle.

IF the Horary distance C S, which is the Hour or Distance of the Sun from the Meridian, be given, in which case the angle AI7, which is equal to it, will be also given, you may find the arc of the Horizon A7, intercepted between the Meridian AEB, and the Hour-circle ISK, in the Triangle A7I, right-angled in A, in which, besides the oblique Angle AI7, or the Horary Distance, you know the side AI, or the height of the Pole, by making *by Probl.* 8. *Chap.* 2. this Analogy,

As the Radius,
To the Sine of the Elevation of the Pole ;
So is the Tangent of the Horary Distance,
To the Tangent of the Arc required.

This Question is also very useful in *Dialling*, for the easy and exact description of Particular and Universal Horizontal Dials, since the Arc of the Horizon intercepted between the Hour-circles and the Meridian, are sensibly equal to the angles of the Hour-lines with the Meridian at the Centre of the Horizontal Dial.

QUE-

QUESTION IX.

The Elevation of the Pole, the Height of the Sun, and its Declination, being given, to find its Azimuth.

IF the Sun be at the Point Q of the Ecliptic EF, and if thro' this Point Q, and thro' the Pole 5 of the Horizon AB, which is called the *Vertical Point*, and also *Zenith*; and thro' the other opposite Pole 3, which is call'd *Nadir*, you imagine the great Circle 5, 6, 3, which is call'd, *The Sun's Azimuth Circle*; and thro' the Poles I, K, of the Equator CD, *the Hour-circle* KQI; the height of the Sun will be the Arc 6 Q, which being known, its complement Q 5 will be also known, and the Declination of the Sun will be QS, which being known, its complement QK will be also known: and since the arc K 5 is also known, because it is the complement of the Elevation of the Pole BK, you may, *by Probl.* 6. *Chap.* 3, find, in the oblique-angled Triangle QK5, whose three sides are known, the Angle K5Q, which is also call'd, *The Sun's Azimuth*, thus: Plate 7. Fig. 64.

Add together these three things, *viz.* the complement of the height of the Pole, the complement of the height of the Sun, and the distance of the Sun from the elevated Pole; and from half their Sum substract separately, the complement of the height of the Sun, and the complement of the Elevation of the Pole, and you have two excesses, then make this Analogy,

As the Product of the Co-sines of the Elevation of the Pole, and of the height of the Sun,
To the Product of the two Excesses;
So is the Square of the Radius;
To a fourth Number,

Whose Square Root will be the Sine of half the Sun's Azimuth from the North.

It is not difficult to perceive, that to find the Sun's Azimuth, when at the Equinoxes, you must make this Analogy,

As the Radius.
To the Tangent of the Height of the Sun;
So is the Tangent of the Elevation of the Pole,
To the Co-sine of the Sun's Azimuth from Noon.

Plate 7. Fig. 64. This Queſtion is alſo very uſeful in *Dialling*, to find the Declination of a Plane, on which you wou'd draw a Dial, by one ſingle Point of ſhade, as we ſhall teach in our *Treatiſe of Dialling*.

QUESTION X.

The Elevation of a Pole, the Height of the Sun, and its Declination, being given, to find the Hour of the Day.

IT will appear as before, that in the oblique-angled Triangle QK5, the three ſides are known, and *by Prob. 6. Chap. 3.* to find the Hour or Hour-diſtance, which is equal to the angle QK5, do thus.

Add together theſe three things, *viz.* the Diſtance of the Sun from the Pole, the complement of the Elevation of the Pole, and the complement of the Height of the Sun, and ſubſtract ſeparately from half their Sum, the Diſtance of the Sun from the Pole, and the complement of the Height of the Pole, and you'll have two exceſſes; then make this Analogy,

As the Product of the Co-ſine of the Elevation of the Pole, and of the Sine of the Diſtance of the Sun from the Pole,
To the Product of the two Exceſſes;
So is the Square of the Radius,
To a fourth Number.

Whoſe Square Root will be the Sine of half the Hour-diſtance required.

It is not ſo hard to find this Hour-diſtance at the Equinoctial Seaſons, nor to find this Analogy,

As the Co-ſine of the Elevation of the Pole,
To the Radius,
So is the Sine of the Height of the Sun,
To the Co-ſine of the Hour-diſtance.

QUESTION XI.

The Obliquity of the Ecliptic, and the Diſtance of the culminating Point from the next Equinox, being given, to find the Angle which the Ecliptic makes with the Meridian.

Fig. 65. WE call by the Name of *Culminating Point*, the Point of the Ecliptic, cut by the Meridian above the Horizon, As if the Horizon were AB, the Equator CD, the Meridian ACBD,

ACBD, and the Ecliptic EGF, E is the *Culminating Point*, whose distance from the next Equinox is EG, which is suppos'd known, and the greatest obliquity of the Ecliptic is the angle CGE, which is also suppos'd known, so that you may find the angle CEG of the Ecliptic with the Meridian, in the Triangle GCE right-angled in C, by making *by Prob.* 6. *Chap.* 2. this Analogy, Plate 7. Fig. 65.

As the Radius,
To the Co-sine of the given Distance;
So is the Tangent of the obliquity of the Ecliptic,
To the Co-tangent of the Angle requir'd.

QUESTION XII.

The Longitudes and Latitudes of two Places on the Earth, being given, to find their Distance.

WE call *Longitude* of a Place its distance from the first Meridian towards the East, and *Latitude* its distance from the Equator towards the next Pole. As if the first Meridian was ACBD, the Equator AB, and the two Poles of the World E, F, and if the Places, whose distance is requir'd be G, H, the Longitude of G will be the angle AEP, or the arc of the Equator AP, terminated by the Meridian EPF, and by the West part of the first Meridian ACE; and its Latitude will be the arc AL or PG, terminated by the parallel Circle LGM, and by the Equator AB. In like manner, the Longitude of H will be the angle AEQ, or the arc of the Equator AQ, terminated by the Meridian EQF, and by the West part of the first Meridian ACE; and its Latitude will be the arc AI or QH, terminated by the parallel Circle IHK, and by the Equator AB.

Since the Longitudes AP, AQ, are known, their difference PQ, or the angle GEH will be also known, which for that reason is call'd *Difference of Longitudes*. Likewise the Latitude PG being known, its complement EG will be also known, and since the Latitude QH is known, its complement EH will be also known, so that in the oblique-angled Triangle GEH, the two sides EG, EH, and the included angle E being known, the third side GH, or the distance GH, which is the arc of the great Circle NGHO, passing thro' the two proposed places G, H, may be found, by drawing the perpendicular GR from the angle G, to its opposite side EH, and making *by Prob.* 12, *Chap.* 3. this Analogy,

As

Plate 7. Fig. 65.

As the Radius,
To the Co-sine of the Angle E;
So is the Tangent of the Side EG,
To the Tangent of the Segment ER.

Which being here ſubſtracted from the known ſide EH, will leave the other Segment HR; then make this other Analogy,

As the Co-ſine of the Segment ER,
To the Co-ſine of the Segment HR;
So is the Co-ſine of the Side EG,
To the Co-ſine of the Side GH.

You may in the ſame manner, find the Diſtance of two Stars, whoſe *Longitudes* are known, which are their Diſtances from the Equinoctial Point ♈, or the *Vernal Equinox*, ſince 'tis in this Point, that the Spring begins; and their *Latitudes* alſo known, which are their Diſtances from the Ecliptic.

F I N I S.

TABLES

OF

Natural *Sines*, *Tangents* and *Secants*,

The Radius being 10000000 Parts;

And alſo of

Artificial *Sines*, *Tangents* and *Secants*,

The Radius being 10000000000 Parts:

Together with

TABLES of *Logarithms* of Natural Numbers, from 1 to 10000.

o Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	0	0	100000.00	0	0
1	29.09	29.09	100000.00	6.4637261	6.4637261
2	58.18	58.18	100000.02	6.7647561	6.7647562
3	87.27	87.27	100000.04	6.9408473	6.9408475
4	116.36	116.36	100000.07	7.0657860	7.0657863
5	145.44	145.44	100000.11	7.1626960	7.1626964
6	174.53	174.53	100000.16	7.2418771	7.2418778
7	203.62	203.62	100000.21	7.3088239	7.3088248
8	232.71	232.71	100000.27	7.3668157	7.3668169
9	261.80	261.80	100000.34	7.4179681	7.4179696
10	290.89	290.89	100000.42	7.4637255	7.4637273
11	319.98	319.98	100000.51	7.5051181	7.5051203
12	349.06	349.07	100000.61	7.5429065	7.5429091
13	378.15	378.16	100000.72	7.5776684	7.5776715
14	407.24	407.25	100000.83	7.6098530	7.6098566
15	436.33	436.33	100000.95	7.6398160	7.6398201
16	465.42	465.42	100001.08	7.6678445	7.6678492
17	494.51	494.51	100001.22	7.6941733	7.6941786
18	523.60	523.60	100001.37	7.7189966	7.7190026
19	552.68	552.69	100001.53	7.7424775	7.7424841
20	581.77	581.78	100001.70	7.7647537	7.7647610
21	610.86	610.87	100001.87	7.7859427	7.7859508
22	639.95	639.96	100002.05	7.8061458	7.8061547
23	669.04	669.05	100002.24	7.8254507	7.8254604
24	698.13	698.14	100002.44	7.8439338	7.8439444
25	727.21	727.23	100002.65	7.8616623	7.8616738
26	756.30	756.32	100002.86	7.8786953	7.8787077
27	785.39	785.41	100003.08	7.8950854	7.8950988
28	814.48	814.50	100003.31	7.9108793	7.9108938
29	843.57	843.60	100003.55	7.9261190	7.9261344
30	872.65	872.69	100003.80	7.9408419	7.9408584

89 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log.* *Sin.*	*Log.* *Tang.*
60	100000.00	Infinites.	Infinites.	10.0000000	Infinites.
59	99999.99	343774667.	343774682.	9.9999999	13.5362739
58	99999.98	171887319.	171887348.	9.9999999	13.2352438
57	99999.96	114591530.	114591574.	9.9999998	13.0591525
56	99999.93	85943630.	85943689.	9.9999997	12.9342137
55	99999.89	68754887.	68754960.	9.9999995	12.8373036
54	99999.85	57295721.	57295809.	9.9999993	12.7581222
53	99999.79	49110600.	49110702.	9.9999991	12.6911752
52	99999.73	42971757.	42971873.	9.9999988	12.6331831
51	99999.66	38197099.	38197230.	9.9999985	12.5820304
50	99999.58	34377371.	34377516.	9.9999982	12.5362727
49	99999.49	31252137.	31252297.	9.9999978	12,4948797
48	99999.39	28647773.	28647948.	9.9999974	12.4570909
47	99999.28	26444080.	26444269.	9.9999969	12.4223285
46	99999.17	24555198.	24555402.	9.9999964	12.3901434
45	99999.05	22918166.	22918385.	9.9999959	12.3601799
44	99998.92	21485762.	21485995.	9.9999953	12.3321508
43	99998.78	20221875.	20222122.	9.9999947	12.3058214
42	99998.63	19098419.	19098680.	9.9999940	12.2809974
41	99998.47	18093220.	18093496.	9.9999934	12.2575159
40	99998.31	17188540.	17188831.	9.9999927	12.2352390
39	99998.13	16370019.	16370325.	9.9999919	12.2140492
38	99997.95	15625908.	15626228.	9.9999911	12.1938453
37	99997.76	14946502.	14946837.	9.9999903	12.1745396
36	99997.56	14323712.	14324061.	9.9999894	12.1560556
35	99979.36	13750745.	13751108.	9.9999885	12.1383262
34	99997.14	13221851.	13222229.	9.9999876	12.1212923
33	99996.92	12732134.	12732526.	9.9999866	12.1049012
32	99996.68	12277396.	12277803.	9.9999856	12.0891062
31	99996.44	11854018.	11854440.	9.9999845	12.0738656
30	99996.19	11458865.	11459301.	9.9999835	12.0591416

o Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	872.65	872.69	100003.80	7.9408419	7.9408584
31	901.74	901.78	100004.06	7.9550819	7.9550996
32	930.83	930.87	100004.33	7.9688698	7.9688886
33	959.92	959.96	100004.61	7.9822334	7.9822534
34	989.00	989.05	100004.89	7.9951980	7.9952192
35	1018.09	1018.14	100005.18	8.0077867	8.0078092
36	1047.18	1047.24	100005.48	8.0200207	8.0200445
37	1076.27	1076.33	100005.79	8.0319195	8.0319446
38	1105.35	1105.42	100006.11	8.0435009	8.0435274
39	1134.44	1134.51	100006.44	8.0547814	8.0548094
40	1163.53	1163.61	100006.77	8.0657763	8.0658057
41	1192.61	1192.70	100007.11	8.0764997	8.0765306
42	1221.70	1221.79	100007.46	8.0869646	8.0869970
43	1250.79	1250.88	100007.82	8.0971832	8.0972172
44	1279.87	1279.98	100008.19	8.1071669	8.1072025
45	1308.96	1309.07	100008.57	8.1169262	8.1169634
46	1338.05	1338.17	100008.96	8.1264710	8.1265099
47	1367.13	1367.26	100009.35	8.1358104	8.1358510
48	1396.22	1396.35	100009.75	8.1449532	8.1449956
49	1425.30	1425.45	100010.16	8.1539075	8.1539516
50	1454.39	1454.54	100010.58	8.1626808	8.1627267
51	1483.48	1483.64	100011.01	8.1712804	8.1713282
52	1512.56	1512.73	100011.45	8.1797129	8.1797626
53	1541.65	1541.83	100011.89	8.1879848	8.1880364
54	1570.73	1570.93	100012.34	8.1961020	8.1961556
55	1599.82	1600.02	100012.80	8.2040703	8.2041259
56	1628.90	1629.12	100013.27	8.2118949	8.2119526
57	1657.99	1658.21	100013.75	8.2195811	8.2196408
58	1687.07	1687.31	100014.24	8.2271335	8.2271953
59	1716.16	1716.41	100014.73	8.2345568	8.2346208
60	1745.24	1745.51	100015.23	8.2418553	8.2419215

89 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	99996.19	11458865.	11459301.	9.9999835	12.0591416
29	99995.93	11089205.	11089656.	9.9999823	12.0449004
28	99995.66	10742648.	10743114.	9.9999812	12.0311114
27	99995.39	10417094.	10417574.	9.9999800	12.0177466
26	99995.11	10110690.	10111185.	9.9999788	12.0047808
25	99994.82	9821794.3	9822303.3	9.9999775	11.9921908
24	99994.52	9548947.5	9549471.1	9.9999762	11.9799555
23	99994.21	9290848.7	9291386.9	9.9999748	11.9680554
22	99993.89	9046333.6	9046886.3	9.9999735	11.9564726
21	99993.56	8814357.2	8814924.4	9.9999721	11.9451906
20	99993.23	8593979.1	8594560.9	9.9999706	11.9341943
19	99992.89	8384350.7	8384947.0	9.9999691	11.9234694
18	99992.54	8184704.1	8185315.0	9.9999676	11.9130030
17	99992.18	7994343.0	7994968.4	9.9999660	11.9027828
16	99991.81	7812634.2	7813274.2	9.9999644	11.8927975
15	99991.43	7639000.9	7639655.4	9.9999628	11.8830366
14	99991.04	7472916.5	7473585.6	9.9999611	11.8734901
13	99990.65	7313899.1	7314582.7	9.9999594	11.8641490
12	99990.25	7161507.0	7162205.2	9.9999577	11.8550044
11	99989.84	7015334.6	7016047.4	9.9999559	11.8460484
10	99989.42	6875008.7	6875736.0	9.9999541	11.8372733
9	99988.99	6740185.4	6740927.2	9.9999522	11.8286718
8	99988.55	6610547.3	6611303.6	9.9999503	11.8202374
7	99988.11	6485800.8	6486571.6	9.9999484	11.8119636
6	99987.66	6365674.1	6366459.5	9.9999464	11.8038444
5	99987.20	6249915.4	6250715.3	9.9999444	11.7958741
4	99986.73	6138290.5	6139105.0	9.9999424	11.7880474
3	99986.25	6030582.0	6031411.0	9.9999403	11.7803592
2	99985.76	5926587.2	5927430.8	9.9999382	11.7728047
1	99985.27	5826117.4	5826975.5	9.9999360	11.7653792
0	99984.77	5728996.2	5729868.9	9.9999338	11.7580785

1 Degree.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
0	1745.24	1745.51	100015.23	8.2418553	8.2419215
1	1774.32	1774.60	100015.74	8.2490352	8.2491015
2	1803.41	1803.70	100016.26	8.2560943	8.2561649
3	1832.49	1832.80	100016.79	8.2630424	8.2631153
4	1861.58	1861.90	100017.33	8.2698810	8.2699563
5	1890.66	1891.00	100017.88	8.2766136	8.2766912
6	1919.74	1920.10	100018.43	8.2832434	8.2833234
7	1948.83	1949.20	100018.99	8.2897734	8.2898559
8	1977.91	1978.30	100019.56	8.2962067	8.2962917
9	2006.99	2007.40	100020.14	8.3025460	8.3026335
10	2036.08	2036.50	100020.73	8.3087941	8.3088842
11	2065.16	2065.60	100021.33	8.3149536	8.3150462
12	2094.24	2094.70	100021.94	8.3210269	8.3211221
13	2123.32	2123.80	100022.55	8.3270163	8.3271143
14	2152.41	2152.91	100023.17	8.3329243	8.3330249
15	2181.49	2182.01	100023.80	8.3387529	8.3388563
16	2210.57	2211.11	100024.44	8.3445043	8.3446105
17	2239.65	2240.21	100025.09	8.3501805	8.3502895
18	2268.73	2269.32	100025.75	8.3557835	8.3558953
19	2297.81	2298.42	100026.41	8.3613150	8.3614297
20	2326.90	2327.53	100027.08	8.3667769	8.3668945
21	2355.98	2356.63	100027.76	8.3721710	8.3722915
22	2385.06	2385.74	100028.45	8.3774988	8.3776223
23	2414.14	2414.84	100029.15	8.3827620	8.3828886
24	2443.22	2443.95	100029.86	8.3879622	8.3880918
25	2472.30	2473.05	100030.58	8.3931008	8.3932336
26	2501.38	2502.16	100031.30	8.3981793	8.3983152
27	2530.46	2531.27	100032.03	8.4031990	8.4033381
28	2559.54	2560.38	100032.77	8.4081614	8.4083037
29	2588.62	2589.48	100033.52	8.4130676	8.4132132
30	2617.69	2618.59	100034.28	8.4179190	8.4180679

88 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
60	99984.77	5728996.2	5729868.8	9.9999338	11.7580785
59	99984.26	5635059.0	5635946.1	9.9999316	11.7508985
58	99983.74	5544151.7	5545053.4	9.9999294	11.7438351
57	99983.21	5456130.0	5457046.3	9.9999271	11.7368847
56	99982.67	5370858.7	5371789.6	9.9999247	11.7300437
55	99982.12	5288210.9	5289156.3	9.9999224	11.7233088
54	99981.57	5208067.3	5209027.2	9.9999200	11.7166766
53	99981.01	5130315.7	5131290.1	9.9999175	11.7101441
52	99980.44	5054850.6	5055839.6	9.9999150	11.7037083
51	99979.86	4981572.6	4982576.2	9.9999125	11.6973665
50	99979.27	4910388.1	4911406.2	9.9999100	11.6911158
49	99978.67	4841208.4	4842241.1	9.9999074	11.6849538
48	99978.06	4773950.1	4774997.3	9.9999047	11.6788779
47	99977.45	4708534.3	4709596.0	9.9999021	11.6728857
46	99976.83	4644886.2	4645962.5	9.9998994	11.6669751
45	99976.20	4582935.1	4584025.9	9.9998966	11.6611437
44	99975.56	4522614.1	4523719.4	9.9998939	11.6553895
43	99974.91	4463859.6	4464979.5	9.9998911	11.6497105
42	99974.25	4406611.3	4407745.8	9.9998882	11.6441047
41	99973.59	4350812.2	4351961.2	9.9998853	11.6385703
40	99972.92	4296407.7	4297571.3	9.9998824	11.6331055
39	99972.24	4243346.4	4244524.5	9.9998794	11.6277085
38	99971.55	4191579.0	4192771.6	9.9998764	11.6223777
37	99970.85	4141058.8	4142266.0	9.9998734	11.6171114
36	99970.14	4091741.2	4092962.9	9.9998703	11.6119082
35	99969.43	4043583.7	4044820.0	9.9998672	11.6067664
34	99968.71	3996546.0	3997796.9	9.9998641	11.6016848
33	99967.98	3950589.5	3951854.8	9.9998609	11.5966619
32	99967.24	3905677.1	3906957.0	9.9998577	11.5916963
31	99966.49	3861773.8	3863068.3	9.9998544	11.5867868
30	99965.73	3818845.9	3820155.0	9.9998512	11.5819321

1 Degree.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	2617.69	2618.59	100034.28	8.4179190	8.4180679
31	2646.77	2647.70	100035.05	8.4227168	8.4228690
32	2675.85	2676.81	100035.82	8.4274621	8.4276176
33	2704.93	2705.92	100036.60	8.4321561	8.4323150
34	2734.01	2735.03	100037.39	8.4367999	8.4369622
35	2763.09	2764.14	100038.19	8.4413944	8.4415603
36	2792.16	2793.25	100039.00	8.4459409	8.4461103
37	2821.24	2822.36	100039.82	8.4504402	8.4506131
38	2850.32	2851.48	100040.65	8.4548934	8.4550699
39	2879.40	2880.59	100041.48	8.4593013	8.4594814
40	2908.47	2909.70	100042.32	8.4636649	8.4638486
41	2937.55	2938.82	100043.17	8.4679850	8.4681725
42	2966.62	2967.93	100044.03	8.4722626	8.4724538
43	2995.70	2997.05	100044.90	8.4764984	8.4766933
44	3024.78	3026.16	100045.78	8.4806932	8.4808920
45	3053.85	3055.28	100046.67	8.4848479	8.4850505
46	3082.93	3084.39	100047.56	8.4889632	8.4891696
47	3112.00	3113.51	100048.46	8.4930398	8.4932502
48	3141.08	3142.63	100049.37	8.4970784	8.4972928
49	3170.15	3171.74	100050.29	8.5010798	8.5012982
50	3199.22	3200.86	100051.22	8.505044/	8.5052671
51	3228.30	3229.98	100052.15	8.5089736	8.5092001
52	3257.37	3259.10	100053.09	8.5128673	8.5130978
53	3286.44	3288.22	100054.05	8.5167264	8.5169610
54	3315.52	3317.34	100055.01	8.5205514	8.5207902
55	3344.59	3346.46	100055.98	8.5243430	8.5245860
56	3373.66	3375.58	100056.96	8.5281017	8.5283490
57	3402.73	3404.71	100057.95	8.5318281	8.5320797
58	3431.81	3433.83	100058.94	8.5355228	8.5357787
59	3460.88	3462.95	100059.94	8.5391863	8.5394466
60	3489.9[illegible]	3492.08	100060.95	8.5428192	8.5430838

88 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	99965.73	3818845.9	3820155.0	9.9998512	11.5819321
29	99964.96	3776861.3	3778184.9	9.9998478	11.5771310
28	99964.19	3735789.2	3737127.3	9.9998445	11.5723824
27	99963.41	3695600.1	3696952.8	9.9998411	11.5676850
26	99962.62	3656265.9	3657633.2	9.9998376	11.5630378
25	99961.82	3617759.6	3619141.4	9.9998342	11.5584397
24	99961.01	3580055.3	3581451.7	9.9998306	11.5538897
23	99960.19	3543128.2	3544539.1	9.9998271	11.5493869
22	99959.36	3506954.6	3508380.0	9.9998235	11.5449301
21	99958.53	3471511.5	3472951.5	9.9998199	11.5405186
20	99957.69	3436777.1	3438231.6	9.9998162	11.5361514
19	99956.84	3402730.3	3404199.4	9.9998125	11.5318275
18	99955.98	3369350.9	3370834.5	9.9998088	11.5275462
17	99955.11	3336619.4	3338117.6	9.9998050	11.5233067
16	99954.24	3304517.3	3306030.0	9.9998012	11.5191080
15	99953.36	3273026.4	3274553.6	9.9997974	11.5149495
14	99952.47	3242129.5	3243671.3	9.9997935	11.5108304
13	99951.57	3211809.9	3213366.3	9.9997896	11.5067498
12	99950.66	3182051.6	3183622.5	9.9997856	11.5027072
11	99949.74	3152839.2	3154424.6	9.9997817	11.4987018
10	99948.81	3124157.7	3125757.7	9.9997776	11.4947329
9	99947.88	3095992.8	3097607.4	9.9997736	11.4907999
8	99946.94	3068330.7	3069959.8	9.9997695	11.4869022
7	99945.99	3041158.0	3042801.7	9.9997653	11.4830387
6	99945.03	3014461.9	3016120.1	9.9997612	11.4792098
5	99944.06	2988229.9	2989902.6	9.9997570	11.4754140
4	99943.08	2962449.9	2964137.3	9.9997527	11.4716510
3	99942.09	2937110.6	2938812.4	9.9997484	11.4679203
2	99941.09	2912200.5	2913916.9	9.9997441	11.4642213
1	99940.09	2887708.9	2889439.8	9.9997398	11.4605534
0	99939.08	2863625.3	2865370.8	9.9997354	11.4569162

2 Degree.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	3489.95	3492.08	100060.95	8.5428192	8.5430838
1	3519.02	3521.20	100061.97	8.5464218	8.5466909
2	3548.09	3550.33	100063.00	8.5499948	8.5502683
3	3577.16	3579.45	100064.04	8.5535386	8.5538166
4	3606.23	3608.58	100065.09	8.5570536	8.5573362
5	3635.30	3637.71	100066.15	8.5605404	8.5608276
6	3664.37	3666.83	100067.21	8.5639994	8.5642912
7	3693.44	3695.96	100068.28	8.5674310	8.5677275
8	3722.51	3725.09	100069.36	8.5708357	8.5711368
9	3751.58	3754.22	100070.45	8.5742139	8.5745197
10	3780.65	3783.35	100071.55	8.5775660	8.5778766
11	3809.71	3812.48	100072.66	8.5808923	8.5812077
12	3838.78	3841.61	100073.77	8.5841933	8.5845136
13	3867.85	3870.74	100074.89	8.5874694	8.5877945
14	3896.91	3899.88	100076.02	8.5907209	8.5910509
15	3925.98	3929.01	100077.16	8.5939483	8.5942832
16	3955.05	3958.14	100078.31	8.5971517	8.5974917
17	3984.11	3987.28	100079.47	8.6003317	8.6006767
18	4013.18	4016.41	100080.63	8.6034886	8.6038386
19	4042.24	4045.55	100081.80	8.6066226	8.6069777
20	4071.31	4074.69	100082.98	8.6097341	8.6100943
21	4100.37	4103.83	100084.17	8.6128235	8.6131889
22	4129.44	4132.96	100085.37	8.6158910	8.6162616
23	4158.50	4162.10	100086.58	8.6189369	8.6193127
24	4187.57	4191.24	100087.80	8.6219616	8.6223427
25	4216.63	4220.38	100089.02	8.6249653	8.6253518
26	4245.69	4249.52	100090.25	8.6279484	8.6283402
27	4274.75	4278.66	100091.49	8.6309111	8.6313083
28	4303.82	4307.81	100092.74	8.6338537	8.6342563
29	4332.88	4336.95	100094.00	8.6367764	8.6371845
30	4361.94	4366.09	100095.27	8.6396796	8.6400931

87 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	99939.08	2863625.3	2865370.8	9.9997354	11.4569162
59	99938.06	2839939.7	2841699.7	9.9997309	11.4533091
58	99937.03	2816642.2	2818416.8	9.9997265	11.4497317
57	99935.99	2793723.3	2795512.5	9.9997220	11.4461834
56	99934.95	2771174.0	2772977.7	9.9997174	11.4426638
55	99933.90	2748985.3	2750803.5	9.9997128	11.4391724
54	99932.84	2727148.6	2728981.4	9.9997082	11.4357088
53	99931.77	2705655.7	2707503.0	9.9997036	11.4322725
52	99930.69	2684498.4	2686360.3	9.9996989	11.4288632
51	99929.60	2663669.0	2665545.5	9.9996942	11.4254803
50	99928.51	2643160.0	2645051.0	9.9996894	11.4221234
49	99927.40	2622963.8	2624869.4	9.9996846	11.4187923
48	99926.29	2603073.6	2604993.7	9.9996798	11.4154864
47	99925.17	2583482.3	2585416.9	9.9996749	11.4122055
46	99924.04	2564183.2	2566132.4	9.9996700	11.4089491
45	99922.90	2545170.0	2547133.7	9.9996650	11.4057168
44	99921.75	2526436.1	2528414.4	9.9996601	11.4025083
43	99920.60	2507975.7	2509968.5	9.9996550	11.3993233
42	99919.44	2489782.6	2491790.0	9.9996500	11.3961614
41	99918.27	2471851.2	2473873.1	9.9996449	11.3930223
40	99917.09	2454175.8	2456212.3	9.9996398	11.3899057
39	99915.90	2436750.9	2438802.0	9.9996346	11.3868111
38	99914.70	2419571.4	2421637.0	9.9996294	11.3837384
37	99913.49	2402632.0	2404712.1	9.9996242	11.3806873
36	99912.28	2385927.7	2388022.4	9.9996189	11.3776573
35	99911.06	2369453.7	2371563.0	9.9996136	11.3746482
34	99909.83	2353205.2	2355329.0	9.9996082	11.3716598
33	99908.59	2337177.7	2339316.1	9.9996028	11.3686917
32	99907.34	2321366.6	2323519.6	9.9995974	11.3657437
31	99906.08	2305767.7	2307935.1	9.9995919	11.3628155
30	99904.82	2290376.5	2292558.6	9.9995865	11.3599069

2 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	4361.94	4366.09	100095.27	8.6396796	8.6400931
31	4391.00	4395.24	100096.55	8.6425634	8.6429825
32	4420.06	4424.38	100097.83	8.6454282	8.6458528
33	4449.12	4453.53	100099.12	8.6482742	8.6487044
34	4478.18	4482.68	100100.42	8.6511016	8.6515375
35	4507.24	4511.82	100101.73	8.6539107	8.6543522
36	4536.30	4540.97	100103.05	8.6567017	8.6571490
37	4565.36	4570.12	100104.38	8.6594748	8.6599279
38	4594.42	4599.27	100105.71	8.6622303	8.6626891
39	4623.47	4628.42	100107.05	8.6649684	8.6654331
40	4652.53	4657.57	100108.40	8.6676893	8.6681598
41	4681.59	4686.73	100109.76	8.6703932	8.6708697
42	4710.64	4715.88	100111.13	8.6730804	8.6735628
43	4739.70	4745.03	100112.51	8.6757510	8.6762393
44	4768.76	4774.19	100113.90	8.6784052	8.6788996
45	4797.81	4803.34	100115.30	8.6810433	8.6815437
46	4826.87	4832.50	100116.70	8.6836654	8.6841719
47	4855.92	4861.66	100118.11	8.6862718	8.6867844
48	4884.98	4890.82	100119.53	8.6888625	8.6893813
49	4914.03	4919.97	100120.96	8.6914379	8.6919629
50	4943.08	4949.13	100122.40	8.6939980	8.6945292
51	4972.14	4978.29	100123.85	8.6965431	8.6970806
52	5001.19	5007.46	100125.30	8.6990734	8.6996173
53	5030.24	5036.62	100126.76	8.7015889	8.7021390
54	5059.29	5065.78	100128.23	8.7040899	8.7046465
55	5088.35	5094.95	100129.71	8.7065766	8.7071395
56	5117.40	5124.11	100131.20	8.7090490	8.7096185
57	5146.45	5153.28	100132.70	8.7115075	8.7120834
58	5175.50	5182.44	100134.20	8.7139520	8.7145345
59	5204.55	5211.61	100135.71	8.7163829	8.7169719
60	5233.60	5240.78	100137.23	8.7188002	8.7193958

87 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	99904.82	2290376.5	2292558.6	9.9995865	11.3599069
29	99903.55	2275189.2	2277385.7	9.9995809	11.3570175
28	99902.27	2260201.5	2262412.6	9.9995753	11.3541472
27	99900.98	2245409.6	2247635.2	9.9995697	11.3512956
26	99899.68	2230809.7	2233049.9	9.9995641	11.3484625
25	99898.37	2216398.0	2218652.8	9.9995584	11.3456478
24	99897.05	2202171.0	2204440.3	9.9995527	11.3428510
23	99895.73	2188125.1	2190409.0	9.9995469	11.3400721
22	99894.40	2174256.9	2176555.3	9.9995411	11.3373109
21	99893.06	2160563.0	2162875.9	9.9995353	11.3345669
20	99891.71	2147040.1	2149367.6	9.9995295	11.3318402
19	99890.35	2133685.1	2136027.2	9.9995236	11.3291303
18	99888.98	2120494.9	2122851.5	9.9995176	11.3264372
17	99887.61	2107466.4	2109837.5	9.9995116	11.3237607
16	99886.23	2094596.6	2096982.4	9.9995056	11.3211004
15	99884.84	2081882.8	2084283.0	9.9994996	11.3184563
14	99883.44	2069322.0	2071736.8	9.9994935	11.3158281
13	99882.03	2056911.5	2059340.9	9.9994874	11.3132156
12	99880.61	2044648.6	2047092.5	9.9994812	11.3106187
11	99879.18	2032530.7	2034989.2	9.9994750	11.3080371
10	99877.75	2020555.3	2023028.4	9.9994688	11.3054708
9	99876.31	2008719.9	2011207.5	9.9994625	11.3029194
8	99874.86	1997021.9	1999524.1	9.9994562	11.3003828
7	99873.40	1985459.1	1987975.8	9.9994498	11.2978610
6	99871.93	1974029.1	1976560.4	9.9994435	11.2953535
5	99870.45	1962729.6	1965275.4	9.9994370	11.2928605
4	99868.97	1951558.4	1954118.7	9.9994306	11.2903815
3	99867.48	1940513.3	1943088.2	9.9994241	11.2879166
2	99865.98	1929592.2	1932181.6	9.9994176	11.2854655
1	99864.47	1918793.0	1921397.0	9.9994110	11.2830281
0	99862.95	1908113.7	1910732.3	9.9994044	11.2806042

3 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	5233.60	5240.78	100137.23	8.7188002	8.7193958
1	5262.64	5269.95	100138.76	8.7212040	8.7218063
2	5291.69	5299.12	100140.30	8.7235946	8.7242035
3	5320.74	5328.29	100141.85	8.7259721	8.7265877
4	5349.79	5357.46	100143.41	8.7283366	8.7289589
5	5378.83	5386.63	100144.98	8.7306882	8.7313174
6	5407.88	5415.81	100146.55	8.7330272	8.7336631
7	5436.93	5444.98	100148.13	8.7353535	8.7359964
8	5465.97	5474.16	100149.72	8.7376675	8.7383172
9	5495.02	5503.33	100151.32	8.7399691	8.7406258
10	5524.06	5532.51	100152.93	8.7422586	8.7429222
11	5553.11	5561.69	100154.55	8.7445360	8.7452067
12	5582.15	5590.87	100156.17	8.7468015	8.7474792
13	5611.19	5620.05	100157.80	8.7490553	8.7497400
14	5640.24	5649.23	100159.44	8.7512973	8.7519892
15	5669.28	5678.41	100161.09	8.7535278	8.7542269
16	5698.32	5707.59	100162.75	8.7557469	8.7564531
17	5727.36	5736.78	100164.42	8.7579546	8.7586681
18	5756.40	5765.96	100166.10	8.7601512	8.7608719
19	5785.44	5795.15	100167.78	8.7623366	8.7630647
20	5814.48	5824.34	100169.47	8.7645111	8.7652465
21	5843.52	5853.52	100171.17	8.7666747	8.7674175
22	5872.56	5882.71	100172.88	8.7688275	8.7695777
23	5901.60	5911.90	100174.60	8.7709697	8.7717274
24	5930.64	5941.09	100176.33	8.7731014	8.7738665
25	5959.67	5970.29	100178.07	8.7752226	8.7759952
26	5988.71	5999.48	100179.81	8.7773334	8.7781136
27	6017.75	6028.67	100181.56	8.7794340	8.7802218
28	6046.78	6057.87	100183.32	8.7815244	8.7823199
29	6075.82	6087.06	100185.09	8.7836048	8.7844079
30	6104.85	6116.26	100186.87	8.7856753	8.7864861

86 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	99862.95	1908113.7	1910732.2	9.9994044	11.2806042
59	99861.42	1897552.3	1900185.4	9.9993978	11.2781937
58	99859.89	1887106.8	1889754.5	9.9993911	11.2757965
57	99858.35	1876775.4	1879437.6	9.9993844	11.2734123
56	99856.80	1866556.2	1869233.0	9.9993776	11.2710411
55	99855.24	1856447.3	1859138.7	9.9993708	11.2686826
54	99853.67	1846447.1	1849153.0	9.9993640	11.2663369
53	99852.09	1836553.7	1839274.2	9.9993572	11.2640036
52	99850.50	1826765.4	1829500.5	9.9993503	11.2616828
51	99848.91	1817080.7	1819830.3	9.9993433	11.2593742
50	99847.31	1807497.7	1810261.9	9.9993364	11.2570778
49	99845.70	1798015.0	1800793.7	9.9993293	11.2547933
48	99844.08	1788631.0	1791424.3	9.9993223	11.2525208
47	99842.45	1779344.2	1782152.0	9.9993152	11.2502600
46	99840.81	1770152.9	1772975.3	9.9993081	11.2480108
45	99839.16	1761055.9	1763892.8	9.9993009	11.2457731
44	99837.51	1752051.6	1754903.0	9.9992938	11.2435469
43	99835.85	1743138.5	1746004.6	9.9992865	11.2413319
42	99834.18	1734315.5	1737196.0	9.9992793	11.2391281
41	99832.50	1725580.9	1728476.1	9.9992720	11.2369353
40	99830.81	1716933.7	1719843.4	9.9992646	11.2347535
39	99829.11	1708372.3	1711296.6	9.9992572	11.2325825
38	99827.41	1699895.7	1702834.6	9.9992498	11.2304223
37	99825.70	1691502.5	1694455.9	9.9992424	11.2282726
36	99823.98	1683191.5	1686159.4	9.9992349	11.2261335
35	99822.25	1674961.4	1677943.9	9.9992274	11.2240048
34	99820.51	1666811.2	1669808.2	9.9992198	11.2218864
33	99818.76	1658739.6	1661751.2	9.9992122	11.2197782
32	99817.01	1650745.5	1653771.7	9.9992046	11.2176801
31	99815.25	1642827.9	1645868.6	9.9991969	11.2155921
30	99813.48	1634985.6	1638040.8	9.9991892	11.2135139

3 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	6104.85	6116.26	100186.87	8.7856753	8.7864861
31	6133.89	6145.46	100188.66	8.7877359	8.7885544
32	6162.92	6174.66	100190.46	8.7897867	8.7906130
33	6191.96	6203.86	100192.26	8.7918278	8.7926620
34	6220.99	6233.06	100194.07	8.7938594	8.7947014
35	6250.02	6262.26	100195.89	8.7958814	8.7967313
36	6279.05	6291.47	100197.72	8.7978941	8.7987519
37	6308.08	6320.67	100199.56	8.7998974	8.8007632
38	6337.11	6349.88	100201.41	8.8018915	8.8027653
39	6366.14	6379.08	100203.26	8.8038764	8.8047583
40	6395.17	6408.29	100205.12	8.8058523	8.8067422
41	6424.20	6437.50	100206.99	8.8078192	8.8087172
42	6453.23	6466.71	100208.87	8.8097772	8.8106834
43	6482.26	6495.92	100210.76	8.8117264	8.8126407
44	6511.29	6525.13	100212.66	8.8136668	8.8145894
45	6540.31	6554.35	100214.57	8.8155985	8.8165294
46	6569.34	6583.56	100216.49	8.8175217	8.8184608
47	6598.36	6612.78	100218.41	8.8194363	8.8203838
48	6627.39	6641.99	100220.34	8.8213425	8.8222984
49	6656.41	6671.21	100222.28	8.8232404	8.8242046
50	6685.44	6700.43	100224.23	8.8251299	8.8261026
51	6714.46	6729.65	100226.19	8.8270112	8.8279924
52	6743.48	6758.87	100228.16	8.8288844	8.8298741
53	6772.51	6788.09	100230.13	8.8307495	8.8317478
54	6801.53	6817.32	100232.11	8.8326066	8.8336134
55	6830.55	6846.54	100234.10	8.8344557	8.8354712
56	6859.57	6875.77	100236.10	8.8362969	8.8373211
57	6888.59	6904.99	100238.11	8.8381304	8.8391633
58	6917.61	6934.22	100240.13	8.8399561	8.8409977
59	6946.63	6963.45	100242.16	8.8417741	8.8428245
60	6975.65	6992.68	100244.19	8.8435845	8.8446437

86 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
30	99813.48	1634985.5	1638040.8	9.9991892	11.2135139
29	99811.70	1627217.4	1630287.3	9.9991815	11.2114456
28	99809.91	1619522.5	1622606.9	9.9991737	11.2093870
27	99808.11	1611899.8	1614998.7	9.9991659	11.2073380
26	99806.30	1604348.2	1607461.7	9.9991580	11.2052986
25	99804.49	1596866.7	1599994.8	9.9991501	11.2032687
24	99802.67	1589454.5	1592597.1	9.9991422	11.2012481
23	99800.84	1582110.4	1585267.6	9.9991342	11.1992368
22	99799.00	1574833.7	1578005.4	9.9991262	11.1972347
21	99797.15	1567623.3	1570809.6	9.9991182	11.1952417
20	99795.29	1560478.4	1563679.3	9.9991101	11.1932578
19	99793.43	1553398.1	1556613.5	9.9991020	11.1912828
18	99791.56	1546381.4	1549611.4	9.9990938	11.1893166
17	99789.68	1539427.6	1542672.1	9.9990856	11.1873593
16	99787.79	1532535.8	1535794.9	9.9990774	11.1854106
15	99785.89	1525705.2	1528978.8	9.9990691	11.1834706
14	99783.98	1518934.9	1522223.1	9.9990608	11.1815392
13	99782.06	1512224.2	1515527.0	9.9990525	11.1796162
12	99780.14	1505572.3	1508889.6	9.9990441	11.1777016
11	99778.21	1498978.4	1502310.3	9.9990357	11.1757954
10	99776.27	1492441.7	1495788.2	9.9990273	11.1738974
9	99774.32	1485961.5	1489322.6	9.9990188	11.1720076
8	99772.36	1479537.2	1482912.8	9.9990103	11.1701259
7	99770.39	1473167.9	1476558.0	9.9990017	11.1682522
6	99768.42	1466852.9	1470257.6	9.9989931	11.1663866
5	99766.44	1460591.6	1464010.9	9.9989845	11.1645288
4	99764.45	1454383.3	1457817.1	9.9989758	11.1626789
3	99762.45	1448227.3	1451676.7	9.9989671	11.1608367
2	99760.44	1442123.0	1445585.9	9.9989584	11.1590023
1	99758.42	1436069.6	1439547.1	9.9989496	11.1571755
0	99756.40	1430066.6	1433558.7	9.9989408	11.1553563

4 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	6975.65	6992.68	100244.19	8.8435845	8.8446437
1	7004.66	7021.91	100246.23	8.8453874	8.8464554
2	7033.68	7051.15	100248.28	8.8471827	8.8482597
3	7062.70	7080.38	100250.34	8.8489707	8.8500566
4	7091.71	7109.61	100252.41	8.8507512	8.8518461
5	7120.73	7138.85	100254.49	8.8525245	8.8536283
6	7149.74	7168.09	100256.58	8.8542905	8.8554034
7	7178.76	7197.33	100258.68	8.8560493	8.8571713
8	7207.77	7226.57	100260.78	8.8578010	8.8589321
9	7236.78	7255.81	100262.89	8.8595457	8.8606859
10	7265.80	7285.05	100265.01	8.8612833	8.8624327
11	7294.81	7314.30	100267.14	8.8630139	8.8641725
12	7323.82	7343.54	100269.28	8.8647376	8.8659055
13	7352.83	7372.79	100271.43	8.8664545	8.8676317
14	7381.84	7402.03	100273.58	8.8681646	8.8693511
15	7410.85	7431.28	100275.74	8.8698680	8.8710638
16	7439.86	7460.53	100277.91	8.8715646	8.8727699
17	7468.87	7489.79	100280.09	8.8732546	8.8744694
18	7497.87	7519.04	100282.28	8.8749381	8.8761623
19	7526.88	7548.29	100284.48	8.8766150	8.8778487
20	7555.89	7577.55	100286.68	8.8782854	8.8795286
21	7584.89	7606.80	100288.89	8.8799493	8.4812022
22	7613.90	7636.06	100291.11	8.8816069	8.8828694
23	7642.90	7665.32	100293.34	8.8832581	8.8845363
24	7671.90	7694.58	100295.58	8.8849031	8.8861850
25	7700.91	7723.84	100297.83	8.8865418	8.8878334
26	7729.91	7753.11	100300.09	8.8881743	8.8894757
27	7758.91	7782.37	100302.36	8.8898007	8.8911119
28	7787.91	7811.64	100304.64	8.8914209	8.8927420
29	7816.91	7840.90	100306.93	8.8930351	8.8943660
30	7845.91	7870.17	100309.22	8.8946433	8.8959842

85 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	99756.40	1430066.6	1433558.7	9.9989408	11.1553563
59	99754.37	1424113.4	1427620.0	9.9989319	11.1535446
58	99752.33	1418209.2	1421730.4	9.9989230	11.1517403
57	99750.28	1412353.6	1415889.4	9.9989141	11.1499434
56	99748.22	1406545.9	1410096.2	9.9989052	11.1481539
55	99746.15	1400785.6	1404350.4	9.9988962	11.1463717
54	99744.07	1395071.9	1398651.4	9.9988871	11.1445966
53	99741.99	1389404.5	1392998.5	9.9988780	11.1428287
52	99739.90	1383782.7	1387391.3	9.9988689	11.1410679
51	99737.80	1378206.0	1381829.1	9.9988598	11.1393141
50	99735.69	1372673.8	1376311.5	9.9988506	11.1375674
49	99733.57	1367185.6	1370837.9	9.9988414	11.1358275
48	99731.44	1361740.9	1365407.7	9.9988321	11.1340945
47	99729.31	1356339.1	1360020.5	9.9988228	11.1323683
46	99727.17	1350979.9	1354675.8	9.9988135	11.1306489
45	99725.02	1345662.5	1349373.1	9.9988041	11.1289362
44	99722.86	1340386.7	1344111.8	9.9987947	11.1272301
43	99720.69	1335151.8	1338891.4	9.9987853	11.1255306
42	99718.51	1329957.4	1333711.6	9.9987758	11.1238377
41	99716.32	1324803.1	1328571.9	9.9987663	11.1221513
40	99714.13	1319688.3	1323471.6	9.9987567	11.1204714
39	99711.93	1314612.7	1318410.6	9.9987471	11.1187978
38	99709.72	1309575.7	1313388.2	9.9987375	11.1171306
37	99707.50	1304576.9	1308404.0	9.9987278	11.1154697
36	99705.27	1299616.0	1303457.6	9.9987181	11.1138150
35	99703.03	1294692.4	1298548.6	9.9987084	11.1121666
34	99700.79	1289805.8	1293676.5	9.9986986	11.1105243
33	99698.54	1284955.7	1288841.0	9.9986888	11.1088881
32	99696.28	1280141.7	1284041.5	9.9986790	11.1072580
31	99694.01	1275363.4	1279277.5	9.9986691	11.1056340
30	99691.73	1270620.5	1274549.5	9.9986591	11.1040158

4 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	7545.91	7870.17	100309.22	8.8946433	8.8959842
31	7874.91	7899.44	100311.52	8.8962455	8.8975963
32	7903.91	7928.71	100313.83	8.8978418	8.8992026
33	7932.90	7957.98	100316.15	8.8994322	8.9008030
34	7961.90	7987.26	100318.48	8.9010168	8.9023977
35	7990.90	8016.53	100320.81	8.9025955	8.9039866
36	8019.89	8045.81	100323.15	8.9041685	8.9055697
37	8048.89	8075.09	100325.50	8.9057358	8.9071472
38	8077.88	8104.37	100327.86	8.9072975	8.9087190
39	8106.87	8133.65	100330.23	8.9088535	8.9102853
40	8135.87	8162.93	100332.61	8.9104039	8.9118460
41	8164.86	8192.21	100335.00	8.9119487	8.9134012
42	8193.85	8221.50	100337.40	8.9134881	8.9149509
43	8222.84	8250.78	100339.80	8.9150219	8.9164952
44	8251.83	8280.07	100342.21	8.9165504	8.9180340
45	8280.82	8309.36	100344.63	8.9180734	8.9195675
46	8309.81	8338.65	100347.06	8.9195911	8.9210957
47	8338.80	8367.94	100349.50	8.9211034	8.9226186
48	8367.78	8397.23	100351.95	8.9226105	8.9241363
49	8396.77	8426.53	100354.41	8.9241123	8.9256487
50	8425.76	8455.83	100356.87	8.9256089	8.9271560
51	8454.74	8485.12	100359.34	8.9271003	8.9286581
52	8483.73	8514.42	100361.82	8.9285866	8.9301552
53	8512.71	8543.72	100364.31	8.9300678	8.9316471
54	8541.69	8573.02	100366.81	8.9315439	8.9331340
55	8570.67	8602.33	100369.32	8.9330150	8.9346160
56	8599.66	8631.63	100371.84	8.9344811	8.9360929
57	8628.64	8660.94	100374.36	8.9359422	8.9375650
58	8657.62	8690.25	100376.89	8.9373983	8.9390321
59	8686.60	8719.56	100379.43	8.9388496	8.9404944
60	8715.57	8748.87	100381.98	8.9402960	8.9419518

85 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Tang. Log.
30	99691.73	1270620.5	1274549.5	9.9986591	11.1040158
29	99689.44	1265912.5	1269856.0	9.9986492	11.1024037
28	99687.15	1261239.0	1265197.1	9.9986392	11.1007974
27	99684.85	1256599.7	1260572.4	9.9986292	11.0991970
26	99682.54	1251994.2	1255981.5	9.9986191	11.0976023
25	99680.22	1247422.1	1251424.0	9.9986090	11.0960134
24	99677.89	1242883.1	1246899.5	9.9985988	11.0944303
23	99675.55	1238376.8	1242407.8	9.9985886	11.0928528
22	99673.20	1233902.8	1237948.4	9.9985784	11.0912810
21	99670.85	1229460.8	1233521.0	9.9985682	11.0897147
20	99668.49	1225050.6	1229125.2	9.9985579	11.0881540
19	99666.12	1220671.6	1224760.8	9.9985475	11.0865988
18	99663.74	1216323.6	1220427.4	9.9985372	11.0850491
17	99661.35	1212006.2	1216124.6	9.9985268	11.0835048
16	99658.95	1207719.2	1211852.2	9.9985163	11 0819660
15	99656.55	1203462.2	1207609.8	9.9985058	11.0804325
14	99654.14	1199234.9	1203397.0	9.9984953	11.0789043
13	99651.72	1195037.0	1199213.7	9.9984848	11.0773814
12	99649.29	1190868.2	1195059.5	9.9984742	11.0758637
11	99646.85	1186728.2	1190934.0	9.9984636	11.0743513
10	99644.40	1182616.7	1186837.0	9.9984529	11.0728440
9	99641.94	1178533.3	1182768.2	9.9984422	11.0713419
8	99639.48	1174477.9	1178727.4	9.9984315	11.0690448
7	99637.01	1170450.0	1174714.1	9.9984207	11.0683529
6	99634.53	1166449.5	1170728.2	9.9984099	11.0668660
5	99632.04	1162476.1	1166769.3	9.9983990	11.0653840
4	99609.54	1158529.4	1162837.2	9.9983881	11.0639071
3	99627.03	1154609.3	1158931.6	9.9983772	11.0624350
2	99624.52	1150715.4	1155052.3	9.9983663	11.0609679
1	99622.00	1146847.4	1151199.0	9.9983553	11.0595056
0	99619.47	1143005.2	1147371.3	9.9983442	11.0580482

5 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	8715.57	8748.87	100381.98	8.9402960	8.9419518
1	8744.55	8778.18	100384.54	8.9417376	8.9434044
2	8773.53	8807.49	100387.11	8.9431743	8.9448523
3	8802.51	8836.81	100389.69	8.9446063	8.9462954
4	8831.48	8866.12	100392.28	8.9460335	8.9477338
5	8860.46	8895.44	100394.87	8.9474561	8.9491676
6	8889.43	8924.76	100397.47	8.9488739	8.9505967
7	8918.40	8954.08	100400.08	8.9502871	8.9520211
8	8947.38	8983.41	100402.70	8.9516957	8.9534410
9	8976.35	9012.73	100405.33	8.9530996	8.9548564
10	9005.32	9042.06	100407.97	8.9544991	8.9562672
11	9034.29	9071.38	100410.61	8.9558940	8.9576735
12	9063.26	9100.71	100413.26	8.9572843	8.9590754
13	9092.23	9130.04	100415.92	8.9586703	8.9604728
14	9121.19	9159.38	100418.59	8.9600517	8.9618659
15	9150.16	9188.71	100421.27	8.9614288	8.9632545
16	9179.13	9218.04	100423.96	8.9628014	8.9646388
17	9208.09	9247.38	100426.66	8.9641697	8.9660188
18	9237.06	9276.72	100429.37	8.9655337	8.9673944
19	9266.02	9306.06	100432.08	8.9668934	8.9687658
20	9294.99	9335.40	100434.80	8.9682487	8.9701330
21	9323.95	9364.74	100437.53	8.9695999	8.9714959
22	9352.91	9394.09	100440.27	8.9709468	8.9728547
23	9381.87	9423.44	100443.02	8.9722895	8.9742092
24	9410.83	9452.78	100445.78	8.9736280	8.9755597
25	9439.79	9482.13	100448.55	8.9749624	8.9769060
26	9468.75	9511.48	100451.33	8.9762926	8.9782483
27	9497.71	9540.84	100454.11	8.9776188	8.9795865
28	9526.66	9570.19	100456.90	8.9789408	8.9809206
29	9555.62	9599.55	100459.70	8.9802589	8.9822507
30	9584.58	9628.90	100462.51	8.9815729	8.9835769

84 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	99619.47	1143005.2	1147371.3	9.9983442	11.0580482
59	99616.93	1139188.5	1143569.2	9.9983332	11.0565956
58	99614.38	1135397.0	1139792.2	9.9983220	11.0551477
57	99611.82	1131630.4	1136040.2	9.9983109	11.0537046
56	99609.26	1127888.5	1132312.9	9.9982997	11.0522662
55	99606.69	1124171.2	1128610.1	9.9982885	11.0508324
54	99604.11	1120478.0	1124931.6	9.9982772	11.0494033
53	99601.52	1116808.9	1121277.0	9.9982660	11.0479789
52	99598.92	1113163.5	1117646.2	9.9982546	11.0465590
51	99596.31	1109541.6	1114038.9	9.9982433	11.0451436
50	99593.69	1105943.1	1110454.9	9.9982318	11.0437328
49	99591.07	1102367.6	1106894.0	9.9982204	11.0423265
48	99588.44	1098815.0	1103356.0	9.9982089	11.0409246
47	99585.80	1095285.0	1099840.6	9.9981974	11.0395272
46	99583.15	1091777.5	1096347.6	9.9981850	11.0381341
45	99580.49	1088292.1	1092876.8	9.9981743	11.0367455
44	99577.82	1084828.8	1089428.1	9.9981626	11.0353612
43	99575.15	1081387.2	1086001.1	9.9981510	11.0339812
42	99572.47	1077967.3	1082595.7	9.9981393	11.0326056
41	99569.78	1074568.7	1079211.7	9.9981275	11.0312342
40	99567.08	1071191.3	1075848.8	9.9981158	11.0298670
39	99564.37	1067834.8	1072507.0	9.9981040	11.0285041
38	99561.65	1064499.2	1069185.9	9.9980921	11.0271453
37	99558.92	1061184.1	1065885.4	9.9980802	11.0257908
36	99556.19	1057889.5	1062605.4	9.9980683	11.0244403
35	99553.45	1054615.1	1059345.5	9.9980563	11.0230940
34	99550.70	1051360.7	1056105.7	9.9980443	11.0217517
33	99547.94	1048126.1	1052885.7	9.9980323	11.0204135
32	99545.17	1044911.2	1049685.4	9.9980202	11.0190794
31	99542.40	1041715.8	1046504.6	9.9980081	11.0177493
30	99539.62	1038539.7	1043343.0	9.9979960	11.0164231

5 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	9584.58	9628.90	100462.51	8.9815729	8.9835769
31	9613.53	9658.26	100465.33	8.9828829	8.9848991
32	9642.48	9687.63	100468.16	8.9841889	8.9862173
33	9671.44	9716.99	100470.99	8.9854910	8.9875317
34	9700.39	9746.35	100473.83	8.9867891	8.9888421
35	9729.34	9775.72	100476.68	8.9880834	8.9901487
36	9758.29	9805.09	100479.54	8.9893737	8.9914514
37	9787.24	9834.46	100482.41	8.9906602	8.9927503
38	9816.19	9863.83	100485.29	8.9919429	8.9940454
39	9845.14	9893.20	100488.18	8.9932217	8.9953367
40	9874.08	9922.57	100491.08	8.9944968	8.9966243
41	9903.03	9951.95	100493.99	8.9957681	8.9979081
42	9931.97	9981.33	100496.90	8.9970356	8.9991883
43	9960.92	10010.71	100499.82	8.9982994	9.0004647
44	9989.86	10040.09	100502.75	8.9995595	9.0017375
45	10018.81	10069.47	100505.69	9.0008160	9.0030066
46	10047.75	10098.85	100508.64	9.0020687	9.0042721
47	10076.69	10128.24	100511.60	9.0033179	9.0055340
48	10105.63	10157.63	100514.57	9.0045634	9.0067924
49	10134.57	10187.02	100517.54	9.0058053	9.0080471
50	10163.51	10216.41	100520.52	9.0070436	9.0092984
51	10192.45	10245.80	100523.51	9.0082784	9.0105461
52	10221.38	10275.20	100526.51	9.0095096	9.0117903
53	10250.32	10304.60	100529.52	9.0107374	9.0130310
54	10279.25	10334.00	100532.54	9.0119616	9.0142682
55	10308.19	10363.40	100535.57	9.0131823	9.0155021
56	10337.12	10392.80	100538.60	9.0143996	9.0167325
57	10366.05	10423.20	100541.64	9.0156135	9.0179594
58	10394.99	10451.60	100544.69	9.0168239	9.0191831
59	10423.92	10481.01	100547.75	9.0180309	9.0204033
60	16452.85	10510.42	100550.82	9.0192346	9.0216202

84 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
30	99539.62	1038539.7	1043343.0	9.9979960	11.0164231
29	99536.83	1035382.7	1040200.7	9.9979838	11.0151009
28	99534.03	1032244.7	1037077.2	9.9979716	11.0137827
27	99531.22	1029125.5	1033972.6	9.9979593	11.0124683
26	99528.40	1026024.9	1030886.6	9.9979470	11.0111579
25	99525.57	1022942.8	1027819.0	9.9979347	11.0098513
24	99522.74	1019878.9	1024769.7	9.9979223	11.0085486
23	99519.90	1016833.2	1021738.5	9.9979099	11.0072497
22	99517.05	1013805.4	1018725.4	9.9978975	11.0059546
21	99514.19	1010795.4	1015730.1	9.9978850	11.0046633
20	99511.32	1007803.1	1012752.2	9.9978725	11.0033757
19	99508.44	1004828.3	1009792.0	9.9978599	11.0020918
18	99505.55	1001870.8	1006849.1	9.9978473	11.0008117
17	99502.66	998930.50	1003923.4	9.9978347	10.9995353
16	99499.76	996007.24	1001014.7	9.9978220	10.9982625
15	90496.85	993100.88	998122.91	9.9978093	10.9969934
14	99493.93	990211.25	995247.87	9.9977966	10.9957279
13	99491.00	987338.23	992389.43	9.9977838	10.9944660
12	99488.06	984481.66	989547.44	9.9977710	10.9932076
11	99485.12	981641.40	986721.76	9.9977582	10.9919529
10	99482.17	978817.32	983912.27	9.9977453	10.9907016
9	99479.21	976009.27	981118.80	9.9977323	10.9894539
8	99476.24	973217.13	978341.24	9.9977194	10.9882097
7	99473.26	970440.75	975579.44	9.9977064	10.9869690
6	99470.27	967680.00	972833.27	9.9976933	10.9857318
5	99467.28	964934.75	970102.60	9.9976803	10.9844979
4	99464.28	962204.86	967387.30	9.9976672	10.9832675
3	99461.27	959490.22	964687.24	9.9976540	10.9820406
2	99458.25	956790.68	962002.29	9.9976408	10.9808169
1	99456.22	954106.13	959332.33	9.9976276	10.9795967
0	99452.18	951436.45	956677.22	9.9976143	10.9783798

6 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	10452.85	10510.42	100550.82	9.0192346	9.0216202
1	10481.78	10539.83	100553.90	9.0204348	9.0228338
2	10510.70	10569.24	100556.99	9.0216318	9.0240441
3	10539.63	10598.66	100560.09	9.0228254	9.0252510
4	10568.56	10628.08	100563.20	9.0240157	9.0264548
5	10597.48	10657.50	100566.31	9.0252027	9.0276552
6	10626.41	10686.92	100569.43	9.0263865	9.0288524
7	10655.33	10716.34	100572.58	9.0275669	9.0300464
8	10684.25	10745.76	100575.70	9.0287442	9.0312373
9	10713.18	10775.19	100578.85	9.0299182	9.0324249
10	10742.10	10804.62	100582.01	9.0310890	9.0336093
11	10771.02	10834.05	100585.18	9.0322567	9.0347906
12	10799.94	10863.48	100588.35	9.0334212	9.0359688
13	10828.85	10892.91	100591.53	6.0345825	9.0371439
14	10857.77	10922.34	100594.72	9.0357407	9.0383159
15	10886.69	10951.78	100597.92	9.0368958	9.0394848
16	10915.60	10981.22	100601.13	9.0380477	9.0406506
17	10944.52	11010.66	100604.35	9.0391966	9.0418134
18	10973.43	11040.10	100607.58	9.0403424	9.0429731
19	11002.34	11069.54	100610.81	9.0414852	9.0441299
20	11031.26	11098.99	100614.05	9.0426249	9.0452836
21	11060.17	11128.44	100617.30	9 0437617	9.0464343
22	11089.08	11157.89	100620.56	9.0448954	9.0475821
23	11117.09	11187.34	100623.83	9.0460261	9.0487270
24	11146.89	11216.79	100627.11	9.0471538	9.0498689
25	11175.80	11246.25	100630.40	9.0482786	9.0510078
26	11204.71	11275.71	100633.70	9.0494005	9.0521439
27	11233.61	11305.17	100637.01	9.0505194	9.0532771
28	11262.52	11334.63	100640.32	9.0516354	9.0544074
29	11291.42	11364.09	100643.64	9.0527485	9.0555349
30	11320.32	11393.56	100646.97	9.0538588	9.0566595

83 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang*
60	99452.18	951436.45	956677.22	9.9976143	10.9783798
59	99449.14	948781.49	954036.86	9.9976011	10.9771662
58	99446.09	946141.16	951411.10	9.9975877	10.9759559
57	99443.03	943515.31	948799.84	9.9975743	10.9747490
56	99439.96	940903.84	946202.96	9.9975609	10.9735452
55	99436.88	938306.63	943620.33	9.9975475	10.9723448
54	99433.79	935723.55	941051.84	9.9975340	10.9711476
53	99430.69	933154.50	938497.38	9.9975205	10.9699536
52	99427.59	930599.36	935956.82	9.9975069	10.9687627
51	99424.48	928058.02	933430.06	9.9974933	10.9675751
50	99421.36	925530.35	930916.99	9.9974797	10.9663907
49	99418.23	923016.27	928417.49	9.9974660	10.9652094
48	99415.09	920515.64	925931.45	9.9974523	10.9640312
47	99411.94	918028.38	923458.77	9.9974386	10.9628561
46	99408.79	915554.36	920999.34	9.9974248	10.9616841
45	99405.63	913093.48	918553.05	9.9974110	10.9605152
44	99402.46	910645.64	916119.80	9.9973971	10.9593494
43	99399.28	908210.74	913699.49	9.9973833	10.9581866
42	99396.09	905788.67	911292.00	9.9973693	10.9570269
41	99392.89	903379.33	908897.25	9.9973554	10.9558701
40	99389.69	900982.61	906515.12	9.9973414	10.9547164
39	99386.48	898598.43	904145.53	9.9973273	10.9535657
38	99383.26	896226.68	901788.37	9.9973132	10.9524179
37	99380.03	893867.26	899443.54	9.9972991	10.9512730
36	99376.79	891520.08	897110.95	9.9972850	10.9501311
35	99373.54	889185.05	894790.51	9.9972708	10.9489922
34	99370.28	886862.06	892482.11	9.9972566	10.9478561
33	99367.02	884551.03	890185.67	9.9972423	10.9467229
32	99363.75	882251.86	887901.09	9.9972280	10.9455926
31	99360.47	879964.46	885628.28	9.9972137	10.9444651
30	99357.18	877688.74	883367.15	9.9971993	10.9433405

6 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	11320.32	11393.56	100646.97	9.0538588	9.0566595
31	11349.22	11423.03	100650.31	9.0549661	9.0577813
32	11378.12	11452.50	100653.66	9.0560706	9.0589002
33	11407.02	11481.97	100657.02	9.0571723	9.0600164
34	11435.92	11511.44	100660.39	9.0582711	9.0611297
35	11464.82	11540.91	100663.77	9.0593671	9.0622403
36	11493.71	11570.39	100665.15	9.0604604	9.0633482
37	11522.61	11599.87	100670.54	9.0615509	9.0644533
38	11551.51	11629.35	100673.94	9.0626386	9.0655556
39	11580.40	11658.83	100677.35	9.0637235	9.0666553
40	11609.29	11688.31	100680.77	9.0648057	9.0677522
41	11638.18	11717.80	100684.20	9.0658852	9.0688455
42	11667.07	11747.29	100687.64	9.0669619	9.0699381
43	11695.96	11776.78	100691.08	9.0680360	9.0710270
44	11724.85	11806.28	100694.53	9.0691074	9.0721133
45	11753.74	11835.78	100697.99	9.0701761	9.0731969
46	11782.63	11865.28	100701.46	9.0712421	9.0742779
47	11811.51	11894.78	100704.94	9.0723055	9.0753563
48	11840.40	11924.28	100708.43	9.0733663	9.0764321
49	11869.28	11953.78	100711.93	9.0744244	9.0775053
50	11898.16	11983.28	100715.44	9.0754799	9.0785760
51	11927.04	12012.79	100718.96	9.0765329	9.0796441
52	11955.93	12042.30	100722.48	9.0755832	9.0807096
53	11984.81	12071.81	100726.01	9.0786310	9.0817726
54	12013.68	12101.32	100729.55	9.0796762	9.0828331
55	12042.56	12130.84	100733.10	9.0807189	9.0838911
56	12071.44	12160.36	100736.66	9.0817590	9.0849466
57	12100.31	12189.88	100740.23	9.0827966	9.0859996
58	12129.19	12219.40	100743.81	9.0838317	9.0870501
59	12158.06	12248.93	100747.40	9.0848643	9.0880981
60	12186.93	12278.46	100750.99	9.0858945	9.0891438

83 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	99357.18	877688.74	883367.15	9.9971993	10.9433405
29	99353.88	875424.61	881117.61	9.9971849	10.9422187
28	99350.58	873171.98	878879.57	9.9971704	10.9410998
27	99347.27	870930.77	876652.95	9.9971559	10.9399836
26	99343.95	868700.88	874437.66	9.9971414	10.9388703
25	99340.62	866482.23	872233.61	9.9971268	10.9377597
24	99337.28	864274.75	870040.71	9.9971122	10.9366518
23	99333.93	862078.33	867858.89	9.9970976	10.9355467
22	99330.57	859892.90	865688.05	9.9970829	10.9344444
21	99327.20	857718.38	863528.12	9.9970682	10.9333447
20	99323.83	855554.68	861379.01	9.9970535	10.9322478
19	99320.45	853401.72	859240.65	9.9970387	10.9311535
18	99317.06	851259.43	857112.95	9.9970239	10.9300619
17	99313.66	849127.72	854995.84	9.9970090	10.9289730
16	99310.25	847006.51	852889.23	9.9969941	10.9278867
15	99306.84	844895.73	850793.04	9.9969792	10.9268031
14	99303.42	842795.31	848707.21	9.9969642	10.9257221
13	99299.99	840705.15	846631.65	9.9969492	10.9246437
12	99296.55	838625.19	844566.29	9.9969342	10.9235679
11	99293.10	836555.36	842511.05	9.9969191	10.9224947
10	99289.64	834495.57	840465.86	9.9969040	10.9214240
9	99286.17	832445.77	838430.65	9.9968888	10.9203559
8	99282.70	830405.86	836405.34	9.9968738	10.9192904
7	99279.22	828375.79	834389.86	9.9968584	10.9182274
6	99275.73	826355.47	832384.15	9.9968431	10.9171669
5	99272.23	824344.85	830388.12	9.9968278	10.9161089
4	99268.72	822343.84	828401.71	9.9968125	10.9150534
3	99265.21	820352 39	826424.85	9.9967971	10.9140004
2	99261.69	818370.41	824457.48	9.9967817	10.9129499
1	99258.16	816397.86	822499.52	9.9967662	10.9119019
0	99254.62	814434.64	820550.90	9.9967507	10.9108562

7 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
0	12186.93	12279.78	100750.99	9.0858945	9.0891438
1	12215.81	12307.99	100754.59	9.0869221	9.0901869
2	12244.68	12337.52	100758.20	9.0879473	9.0912277
3	12273.55	12367.05	100761.82	9.0889700	9.0922660
4	12302.41	12396.58	100765.45	9.0899903	9.0933020
5	12331.28	12426.12	100769.09	9.0910082	9.0943355
6	12360.15	12455.66	100772.74	9.0920237	9.0953669
7	12389.01	12485.20	100776.39	9.0930367	9.0963955
8	12417.88	12514.74	100780.05	9.0940474	9.0974219
9	12446.74	12544.29	100783.72	9.0950556	9.0984460
10	12475.60	12573.84	100788.40	9.0960615	9.0994678
11	12504.46	12603.39	100791.09	9.0970651	9.1004872
12	12533.32	12632.94	100794.79	9.0980662	9.1015044
13	12562.18	12662.49	100798.50	9.0990651	9.1025192
14	12591.04	12692.05	160802.22	9.1000616	9.1035317
15	12619.90	12721.61	100805.95	9.1010558	9.1045420
16	12648.75	12751.17	100809.69	9.1020477	9.1055500
17	12677.61	12780.73	100813.43	9.1030373	9.1065557
18	12706.46	12810.29	100817.18	9.1040246	9.1075591
19	12735.31	12839.86	100820.94	9.1050096	9.1085604
20	12764.16	12869.43	100824.71	9.1059924	9.1095594
21	12793.01	12899.00	100828.49	9.1069729	9.1105562
22	12821.86	12928.57	100832.28	9.1079512	9.1115508
23	12850.71	12958.15	100836.07	9.1089272	9.1125431
24	12879.56	12987.73	100839.88	9.1099010	9.1135333
25	12908.41	13017.31	100843.70	9.1108726	9.1145213
26	12937.25	13046.89	100847.52	9.1118420	9.1155072
27	12966.09	13076.48	100851.35	9.1128092	9.1164909
28	12994.94	13106.07	100855.19	9.1137742	9.1174728
29	13023.78	13135.66	100859.04	9.1147370	9.1184511
30	13052.62	13165.25	100862.90	9.1156977	9.1194294

82 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
60	99254.62	814434.64	820550.90	9.9967507	10.9108562
59	99251.07	812480.71	818611.57	9.9967352	10.9098131
58	99247.51	810535.99	816681.45	9.9967196	10.9087723
57	99243.94	808600.42	814760.48	9.9997040	10.9077340
56	99240.36	806673.94	812848.60	9.9966884	10.9066980
55	99236.78	804756.47	810945.73	9.9966727	10.9056645
54	99233.19	802847.96	809051.82	9.9966570	10.9046333
53	99229.59	800948.35	807166.81	9.9966412	10.9036045
52	99225.98	799057.56	805290.62	9.9966254	10.9025781
51	99222.36	797175.55	803423.21	9.9966096	10.9015540
50	99218.74	795302.24	801564.50	9.9965937	10.9005322
49	99215.11	793437.58	799714.45	9.9965778	10.8995128
48	99211.47	791581.51	797872.98	9.9965619	10.8984956
47	99207.82	789733.96	796040.03	9.9965459	10.8974808
46	99204.16	787894.89	794215.56	9.9965299	10.8964683
45	99200.49	786064.23	792399.50	9.9965138	10.8954580
44	99196.81	784241.91	790591.79	9.9964977	10.8944500
43	99193.13	782427.90	788792.38	9.9964816	10.8934443
42	99189.44	780622.12	787001.20	9.9964655	10.8924409
41	99185.74	778824.53	785218.21	9.9964493	10.8914396
40	99182.03	777035.06	783443.35	9.9964330	10.8904406
39	99178.31	775253.66	781676.56	9.9964167	10.8894438
38	99174.59	773480.28	779917.78	9.9964004	10.8884492
37	99170.86	771714.86	778166.97	9.9963841	10.8874569
36	99167.12	769957.35	776424.06	9.9963677	10.8864667
35	99163.37	768207.69	774689.01	9.9963513	10.8854787
34	99159.61	766465.84	772961.76	9.9963348	10.8844928
33	99155.84	764731.74	771242.27	9.9963183	10.8835091
32	99152.06	763005.33	769530.47	9.9963018	10.8825276
31	99148.28	761286.57	767826.31	9.9962852	10.8815482
30	99144.49	759575.41	766129.76	9.9962686	10.8805709

7 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	13054.62	13165.25	100862.90	9.1156977	9.1194291
31	13081.46	13194.84	100866.77	9.1166562	9.1204043
32	13110.30	13224.44	100870.65	9.1176125	9.1213773
33	13139.13	13254.04	100874.53	9.1185667	9.1223482
34	13167.97	13283.64	100878.42	9.1195188	9.1233171
35	13196.81	13313.24	100882.32	9.1204688	9.1242839
36	13225.64	13342.85	100886.23	9.1214167	9.1252486
37	13254.47	13372.46	100890.15	9.1223624	9.1262112
38	13283.30	13402.07	100894.08	9.1233061	9.1271718
39	13312.13	13431.68	100898.02	9.1242477	9.1281303
40	13340.96	13461.29	100901.97	9.1251872	9.1290868
41	13369.79	13490.91	100905.92	9.1261246	9.1300413
42	13398.62	13520.53	100909.88	9.1270600	9.1309937
43	13427.44	13550.15	100913.85	9.1279934	9.1319442
44	13456.27	13579.77	100917.83	9.1289247	9.1328926
45	13485.09	13609.40	100921.82	9.1298539	9.1338391
46	13513.92	13639.03	100925.82	9.1307812	9.1347835
47	13542.74	13668.66	100929.83	9.1317064	9.1357260
48	13571.56	13698.29	100933.85	9.1326297	9.1366665
49	13600.38	13727.93	100937.88	9.1335509	9.1376051
50	13629.19	13757.57	100941.92	9.1344702	9.1385417
51	13658.01	13787.21	100945.96	9.1353875	9.1394764
52	13686.83	13816.85	100950.01	9.1363028	9.1404092
53	13715.64	13846.50	100954.07	9.1372161	9.1413400
54	13744.45	13876.15	100958.14	9.1381275	9.1422689
55	13773.27	13905.80	100962.22	9.1390370	9.1431959
56	13802.08	13935.45	100966.31	9.1399445	9.1441210
57	13830.89	13965.10	100970.41	9.1408501	9.1450442
58	13859.70	13994.76	100974.52	9.1417537	9.1459655
59	13888.50	14024.42	100978.64	9.1426555	9.1468850
60	13917.31	14054.08	100982.76	9.1435553	9.1478025

82 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
30	99144.49	759575.41	766129.76	9.9962686	10.8805709
29	99140.69	757871.79	764440.75	9.9962519	10.8795957
28	99136.88	756175.67	762759.23	9.9962352	10.8786227
27	99133.06	754486.99	761085.16	9.9962185	10.8776518
26	99129.23	752805.71	759418.49	9.9962017	10.8766829
25	99125.39	751131.78	757759.16	9.9961849	10.8757161
24	99121.55	749465.14	756107.13	9.9961681	10.8747514
23	99117.70	747805.76	754462.36	9.9961512	10.8737888
22	99113.84	746153.57	752824.78	9.9961343	10.8728282
21	99109.97	744508.55	751194.37	9.9961174	10.8718697
20	99106.09	742870.64	749571.06	9.9961004	10.8709132
19	99102.21	741239.78	747954.82	9.9960834	10.8699587
18	99098.32	739615.95	746345.60	9.9960663	10.8690063
17	99094.41	737999.09	744743.35	9.9960492	10.8680558
16	99090.51	736389.16	743148.03	9.9960321	10.8671074
15	99086.59	734786.10	741559.59	9.9960149	10.8661609
14	99082.66	733189.89	739977.98	9.9959977	10.8652165
13	99078.72	731600.47	738403.18	9.9959804	10.8642740
12	99074.78	730017.80	736835.12	9.9959631	10.8633335
11	99070.83	728441.84	735273.77	9.9959458	10.8623949
10	99066.87	726872.55	733719.09	9.9959284	10.8614583
9	99062.90	725309.87	732171.02	9.9959111	10.8605236
8	99058.92	723753.78	730629.54	9.9958936	10.8595908
7	99054.93	722204.22	729094.60	9.9958761	10.8586600
6	99050.94	720661.16	727566.16	9.9958586	10.8577311
5	99046.94	719124.56	726044.17	9.9958411	10.8568041
4	99042.93	717594.37	724528.59	9.9958235	10.8558790
3	99038.91	716070.56	723019.40	9.9958059	10.8549558
2	99034.88	714553.08	721516.53	9.9957882	10.8540345
1	99030.84	713041.90	720019.96	9.9957705	10.8531150
0	99026.80	711536.97	718529.65	9.9957528	10.8521975

8 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	13917.31	14054.08	100982.76	9.1435553	9.1478025
1	13946.12	14083.74	100986.89	9.1444532	9.1487182
2	13974.92	14113.41	100991.03	9.1453493	9.1496321
3	14003.72	14143.08	100995.18	9.1462435	9.1505441
4	14032.52	14172.75	100999.34	9.1471358	9.1514543
5	14061.32	44202.43	101003.51	9.1480262	9.1523627
6	14090.12	14232.11	101007.69	9.1489148	9.1532692
7	14118.92	14261.79	101011.88	9.1498015	9.1541739
8	14147.72	14291.47	101016.07	9.1506864	9.1550769
9	14176.51	14321.15	101020.27	9.1515694	9.1559780
10	14205.31	14350.84	101024.48	9.1524507	9.1568773
11	14234.10	14380.53	101028.70	9.1533301	9.1577748
12	14262.89	14410.22	101032.93	9.1542076	9.1586706
13	14291.68	14439.91	101037.17	7.1550834	9.1595646
14	14320.47	14469.61	101041.42	9.1559574	9.1604569
15	14349.26	14499.31	101045.68	9.1568296	9.1613473
16	14378.05	14529.01	101049.95	9.1577000	9.1622361
17	14406.84	14558.71	101054.23	9.1585686	9.1631231
18	14435.62	14588.42	101058.51	9.1594354	9.1640083
19	14464.40	14618.13	101062.80	9.1603005	9.1648919
20	14493.19	14647.84	101067.10	9.1611639	9.1657737
21	14521.97	14677.55	101071.41	9.1620254	9.1666538
22	14550.75	14707.27	101075.73	9.1628853	9.1675322
23	14579.53	14736.99	101080.06	9.1637434	9.1684089
24	14608.30	14766.71	101084.40	9.1645998	9.1692839
25	14637.08	14796.44	101088.75	9.1654544	9.1701572
26	14665.85	14826.17	101093.11	9.1663074	9.1710289
27	14694.63	14855.90	101097.47	9.1671586	9.1718989
28	14723.40	14885.63	101101.84	9.1680081	9.1727672
29	14752.17	14915.36	101106.22	9.1688559	9.1736338
30	14780.94	14945.10	101110.61	9.1697021	9.1744988

81 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	99026.80	711536.97	718529.65	9.9957528	10.8521975
59	99022.75	710038.26	717045.56	9.9957350	10.8512818
58	99018.69	708545.73	715567.64	9.9957172	10.8503679
57	99014.62	707059.34	714095.87	9.9956993	10.8494559
56	99010.54	705579.05	712630.19	9.9956815	10.8485457
55	99006.45	704104.82	711170.58	9.9956635	10.8476373
54	99002.36	702636.62	709717.00	9.9956456	10.8467308
53	98998.26	701174.41	708269.41	9.9956276	10.8458261
52	98994.15	699718.06	706827.77	9.9956095	10.8449231
51	98990.03	698267.81	705392.05	9.9955915	10.8440220
50	98985.90	696823.35	703962.20	9.9955734	10.8431227
49	98981.76	695384.73	702538.20	9.9955552	10.8422252
48	98977.62	693951.92	701120.01	9.9955370	10.8413294
47	98973.47	692524.89	699707.60	9.9955188	10.8404354
46	98969.31	691103.59	698300.92	9.9955005	10.8395431
45	98965.14	689687.99	696899.94	9.9954822	10.8386527
44	98960.96	688278.07	695504.64	9.9954639	10.8377639
43	98956.77	686873.78	694114.96	9.9954455	10.8368769
42	98952.57	685475.08	692730.89	9.9954271	10.8359917
41	98948.37	684081.96	691352.39	9.9954087	10.8351081
40	98944.16	682694.37	689979.42	9.9953902	10.8342263
39	98939.94	681312.27	688611.95	9.9953717	10.8333462
38	98935.71	679935.65	687249.95	9.9953531	10.8324678
37	98931.47	678564.46	685893.38	9.9953345	10.8315911
36	98927.23	677198.67	684542.22	9.9953159	10.8307161
35	98922.98	675838.26	683196.42	9.9952972	10.8298428
34	98918.72	674483.19	681855.97	9.9952785	10.8289711
33	98914.45	673133.41	680520.82	9.9952597	10.8281011
32	98910.17	671788.91	679190.95	9.9952409	10.8272328
31	98905.88	670449.66	677866.32	9.9952221	10.8263662
30	98901.58	669115.62	676546.91	9.9952033	10.8255012

8 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	14780.94	14945.10	101110.61	9.1697021	9.1744988
31	14809.71	14974.84	101115.01	9.1705465	9.1753622
32	14838.48	15004.58	101119.42	9.1713893	9.1762239
33	14867.24	15034.33	101123.84	9.1722305	9.1770840
34	14896.01	15064.08	101128.27	9.1730699	9.1779425
35	14924.77	15093.83	101132.71	9.1739077	9.1787993
36	14953.53	15123.58	101137.15	9.1747439	9.1796546
37	14982.30	15153.33	101141.60	9.1755784	9.1805082
38	15011.06	15183.09	101146.06	9.1764112	9.1813602
39	15039.81	15212.85	101150.53	9.1772425	9.1822106
40	15068.57	15242.61	101155.01	9.1780721	9.1830595
41	15097.33	15272.38	101159.50	9.1789001	9.1839068
42	15126.08	15302.15	101164.00	9.1797265	9.1847525
43	15154.84	15331.92	101168.51	9.1805512	9.1855966
44	15183.59	15361.89	101173.03	9.1813744	9.1864392
45	15212.34	15391.47	101177.56	9.1821960	9.1872802
46	15241.09	15421.25	101182.09	9.1830160	9.1881196
47	15269.84	15451.03	101186.63	9.1838344	9.1889575
48	15298.58	15480.82	101191.18	9.1846512	9.1897939
49	15327.33	15510.61	101195.74	9.1854665	9.1906287
50	15356.07	15540.40	101200.31	9.1862802	9.1914621
51	15384.82	15570.19	101204.89	9.1870923	9.1922939
52	15413.56	15599.98	101209.48	9.1879029	9.1931241
53	15442.30	15629.78	101214.08	9.1887120	9.1939529
54	15471.04	15659.58	101218.69	9.1895195	9.1947802
55	15499.78	15689.38	101223.31	9.1903254	9.1956059
56	15528.51	15719.19	101227.93	9.1911299	9.1964302
57	15557.25	15749.00	101232.56	9.1919328	9.1972530
58	15585.98	15778.81	101237.20	9.1927342	9.1980743
59	15614.72	15808.62	101241.85	9.1935341	9.1988941
60	15643.45	15838.44	111246.51	9.1943324	9.1997125

81 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Tang. Log
30	98901.58	669115.62	676546.91	9.9952033	10.8255012
29	98897.28	667786.77	675232.68	9.9951844	10.8246378
28	98892.97	666463.07	673923.60	9.9951654	10.8237761
27	98888.65	665144.49	672619.65	9.9951464	10.8229160
26	98884.32	663831.00	671320.79	9.9951274	10.8220575
25	98879.98	662522.58	670026.99	9.9951084	10.8212007
24	98875.63	661219.19	668738.22	9.9950893	10.8203454
23	98871.28	659920.80	667454.46	9.9950702	10.8194918
22	98866.92	658627.39	666175.68	9.9950510	10.8186398
21	98862.55	657338.92	664901.84	9.9950318	10.8177894
20	98858.17	656055.38	663632.93	9.9950126	10.8169405
19	98853.78	654776.72	662368.90	9.9949933	10.8160932
18	98849.38	653502.93	661109.73	9.9949740	10.8152475
17	98844.98	652233.96	659855.40	9.9949546	10.8144034
16	98840.57	650969.81	658605.87	9.9949352	10.8135608
15	98836.15	649710.43	657361.12	9.9949158	10.8127198
14	98831.72	648455.81	656121.13	9.9948964	10.8118804
13	98827.28	647205.91	654885.86	9.9948769	10.8110425
12	98822.83	645960.70	653655.28	9.9948573	10.8102061
11	98818.38	644720.17	652429.38	9.9948377	10.8093713
10	98813.92	643484.28	651208.12	9.9948181	10.8085379
9	98809.45	642253.01	649991.48	9.9947985	10.8077061
8	98804.97	641026.33	648779.44	9.9947788	10.8068759
7	98800.48	639804.22	647571.95	9.9947591	10.8060471
6	98795.98	638586.65	646369.01	9.9947393	10.8052198
5	98791.48	637373.59	645170.59	9.9947195	10.8043941
4	98786.97	636165.02	643976.66	9.9946997	10.8035698
3	98782.45	634960.92	642787.19	9.9946798	10.8027470
2	98777.92	633761.26	641602.16	9.9946599	10.8019257
1	98773.38	632566.01	640421.54	9.9946399	10.8011059
0	98768.83	631375.15	639245.32	9.9946199	10.8002875

9 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
0	15643.45	15838.44	101246.51	9.1943324	9.1997125
1	15672.18	15868.26	101251.18	9.1951293	9.2005294
2	15700.91	15898.08	101255.86	9.1959247	9.2013449
3	15729.63	15927.91	101260.55	9.1967186	9.2021588
4	15758.36	15957.74	101265.25	9.1975110	9.2029714
5	15787.08	15987.57	101269.96	9.1983019	9.2037825
6	15815.81	16017.40	101274.67	9.1990913	9.2045922
7	15844.53	16047.24	101279.39	9.1998793	9.2054004
8	15873.25	16077.08	101284.12	9.2006658	9.2062072
9	15901.97	16106.92	101288.86	9.2014509	9.2070126
10	15930.69	16136.77	101293.61	9.2022345	9.2078165
11	15959.40	16166.62	101298.37	9.2030167	9.2086191
12	15988.12	16196.47	101303.14	9.2037974	9.2094203
13	16016.83	16226.32	101307.92	9.2045766	9.2102200
14	16045.55	16256.17	101312.71	9.2053545	9.2110184
15	16074.26	16286.03	101317.51	9.2061309	9.2118153
16	16102.97	16315.89	101322.31	9.2069059	9.2126109
17	16131.67	16345.76	101327.12	9.2076795	9.2134051
18	16160.38	16375.63	101331.94	9.2084516	9.2141980
19	16189.09	16405.50	101336.77	9.2092224	9.2149894
20	16217.79	16435.37	101341.61	9.2099917	9.2157795
21	16246.50	16465.25	101346.46	9.2107597	9.2165683
22	16275.20	16495.13	101351.32	9.2115263	9.2173556
23	16303.90	16525.01	101356.19	9.2122914	9.2181417
24	16332.60	16554.89	101361.07	9.2130552	9.2189264
25	16361.29	16584.78	101365.95	9.2138176	9.2197097
26	16389.99	16614.67	101370.84	9.2145787	9.2204917
27	16418.68	16644.56	101375.74	9.2153384	9.2212724
28	16447.38	16674.46	101380.65	9.2160967	9.2220518
29	16476.07	16704.36	101385.57	9.2168536	9.2228298
30	16504.76	16734.26	101390.50	9.2176092	9.2236065

80 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	98768.83	631375.15	639245.32	9.9946199	10.8002875
59	98764.28	630188.66	638073.47	9.9945999	10.7994706
58	98759.72	629006.51	636905.95	9.9945798	10.7986551
57	98755.15	627828.68	635742.76	9.9945597	10.7978411
56	98750.57	626655.14	634583.86	9.9945396	10.7970286
55	98745.98	625485.88	633429.23	9.9945194	10.7962175
54	98741.38	624320.86	632278.84	9.9944992	10.7954078
53	98736.77	623160.07	631132.69	9.9944789	10.7945996
52	98732.16	622003.47	629990.73	9.9944587	10.7937928
51	98727.54	620851.06	628852.95	9.9944383	10.7929874
50	98722.91	619702.79	627719.33	9.9944180	10.7921835
49	98718.27	618558.67	626589.84	9.9943975	10.7913809
48	98713.62	617418.65	625464.46	9.9943771	10.7905797
47	98708.97	616282.72	624343.16	9.9943566	10.7897800
46	98704.31	615150.85	623225.94	9.9943361	10.7889816
45	98699.64	614023.03	622112.75	9.9943156	10.7881847
44	98694.96	612899.23	621003.59	9.9942950	10.7873891
43	98690.27	611779.43	619898.43	9.9942743	10.7865949
42	98685.57	610663.60	618797.25	9.9942537	10.7858020
41	98680.86	609551.74	617700.03	9.9942330	10.7850106
40	98676.15	608443.81	616606.74	9.9942122	10.7842205
39	98671.43	607339.79	615517.36	9.9941914	10.7834317
38	98666.70	606239.67	614431.89	9.9941706	10.7826444
37	98661.96	605143.43	613350.28	9.9941498	10.7818583
36	98657.21	604051.03	612272.53	9.9941289	10.7810736
35	98652.46	602962.47	611198.61	9.9941079	10.7802903
34	98647.70	601877.72	610128.50	9.9940870	10.7795083
33	98642.93	600796.76	609062.19	9.9940659	10.7787276
32	98638.15	599719.57	607999.64	9.9940449	10.7779482
31	98633.36	598646.14	606940.85	9.9940238	10.7771702
30	98628.56	597576.44	605885.80	9.9940027	10.7763935

9 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	16504.76	16734.26	101390.50	9.2176092	9.2236065
31	16533.45	16764.16	101395.44	9.2183635	9.2243819
32	16562.14	16794.07	101400.39	9.2191164	9.2251561
33	16590.82	16823.98	101405.35	9.2198680	9.2259289
34	16619.51	16853.89	101410.32	9.2206182	9.2267004
35	16648.19	16883.81	101415.30	9.2213671	9.2274706
36	16676.87	16913.73	101420.29	9.2221147	9.2282395
37	16705.55	16943.65	101425.29	9.2228609	9.2290071
38	16734.23	16973.58	101430.29	9.2236059	9.2297735
39	16762.91	17003.51	101435.30	9.2243495	9.2305386
40	16791.59	17033.44	101440.32	9.2250918	9.2313024
41	16820.26	17063.37	101445.35	9.2250328	9.2320650
42	16848.94	17093.31	101450.39	9.2265725	9.2328262
43	16877.61	17123.25	101455.44	9.2273110	9.2335863
44	16906.28	17153.19	101460.50	9.2280481	9.2343451
45	16934.95	17183.14	101465.57	9.2287839	9.2351026
46	16963.62	17213.09	101470.64	9.2295185	9.2358589
47	16992.28	17243.04	101475.72	9.2302518	9.2366139
48	17020.95	17273.00	101480.81	9.2309838	9.2373678
49	17049.61	17302.96	101485.91	9.2317145	9.2381203
50	17078.28	17332.92	101491.02	9.2324440	9.2388717
51	17106.94	17362.88	101496.14	9.2331722	9.2396218
52	17135.60	17392.85	101501.27	9.2338992	9.2403708
53	17164.25	17422.82	101506.41	9.2346249	9.2411185
54	17192.91	17452.79	101511.56	9.2353494	9.2418650
55	17221.56	17482.77	101516.72	9.2360726	9.2426103
56	17250.22	17512.75	101521.89	9.2367946	9.2433543
57	17278.87	17542.73	101527.07	9.2375153	9.2440972
58	17307.52	17572.72	101532.26	9.2382349	9.2448389
59	17336.17	17602.71	101537.46	9.2389532	9.2455794
60	17364.82	17632.70	101542.67	9.2396702	9.2463188

80 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	98628.56	597576.44	605885.80	9.9940027	10.7763935
29	98623.75	596510.45	604834.45	9.9939815	10.7756181
28	98618.94	595448.15	603786.80	9.9939603	10.7748439
27	98614.12	594389.52	602742.82	9.9939391	10.7740711
26	98609.29	593334.55	601702.50	9.9939178	10.7732996
25	98604.45	592283.22	600665.81	9.9938965	10.7725294
24	98599.60	591235.50	599632.74	9.9938752	10.7717605
23	98594.74	590191.38	598603.26	9.9938538	10.7709929
22	98589.88	589150.84	597577.37	9.9938324	10.7702265
21	98585.01	588113.86	596555.04	9.9938109	10.7694614
20	98580.13	587080.42	595536.25	9.9937894	10.7686976
19	98575.24	586050.51	594520.98	9.9937679	10.7679350
18	98570.34	585024.10	593509.22	9.9937463	10.7671738
17	98565.44	584001.17	592500.95	9.9937247	10.7664137
16	98560.53	582981.72	591496.14	9.9937030	10.7656549
15	98555.61	581965.72	590494.79	9.9936813	10.7648974
14	98550.68	580953.15	589496.88	9.9936596	10.7641411
13	98545.74	579944.00	588502.38	9.9936378	10.7633861
12	98540.79	578938.25	587511.28	9.9936160	10.7626322
11	98535.83	577935.88	586523.56	9.9935942	10.7618797
10	98530.87	576936.88	585539.20	9.9935723	10.7611283
9	98525.90	575941.22	584558.20	9.9935504	10.7603782
8	98520.92	574948.89	583580.53	9.9935285	10.7596292
7	98515.93	573959.88	582606.17	9.9935065	10.7588815
6	98510.93	572974.16	581635.10	9.9934844	10.7581350
5	98505.92	571991.73	580667.32	9.9934624	10.7573897
4	98500.91	571012.56	579702.80	9.9934403	10.7566457
3	98495.89	570036.63	578741.53	9.9934181	10.7559028
2	98490.86	569063.94	577783.50	9.9933959	10.7551611
1	98485.82	568094.46	576828.67	9.9933737	10.7544206
0	98480.77	567128.18	575877.05	9.9933515	10.7536812

10 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	17364.82	17632.70	101542.67	9.2396702	9.2463188
1	17393.46	17662.69	101547.88	9.2403861	9.2470569
2	17422.11	17692.69	101553.10	9.2411007	9.2477939
3	17450.75	17722.69	101558.33	9.2418141	9.2485297
4	17479.39	17752.69	101563.57	9.2425264	9.2492643
5	17508.03	17782.70	101568.82	9.2432374	9.2499978
6	17536.67	17812.71	101574.08	9.2439472	9.2507301
7	17565.31	17842.72	101579.35	9.2446558	9.2514612
8	17593.95	17872.74	101584.63	9.2453632	9.2521912
9	17622.58	17902.76	101589.92	9.2460695	9.2529200
10	17651.21	17932.78	101595.21	9.2467746	9.2536477
11	17679.84	17962.81	101600.51	9.2474784	9.2543743
12	17708.47	17992.84	101605.82	9.2481811	9.2550997
13	17737.10	18022.87	101611.14	9.2488827	9.2558240
14	17765.73	18052.91	101616.47	9.2495830	9.2565472
15	17794.35	18082.95	101621.81	9.2502822	9.2572692
16	17822.98	18112.99	101627.16	9.2509803	9.2579901
17	17851.60	18143.03	101632.52	9.2516772	9.2587099
18	17880.22	18173.08	101637.89	9.2523729	9.2594285
19	17908.84	18203.13	101643.27	9.2530675	9.2601461
20	17937.46	18233.18	101648.66	9.2537609	9.2608625
21	17966.07	18263.24	101654.06	9.2544532	9.2615779
22	17994.69	18293.30	101659.46	9.2551444	9.2622921
23	18023.30	18323.36	101664.87	9.2558344	9.2630053
24	18051.91	18353.43	101670.29	9.2565233	9.2637173
25	18080.52	18383.50	101675.72	9.2572110	9.2644283
26	18109.13	18413.57	101681.16	9.2578977	9.2651382
27	18137.74	18443.65	101686.61	9.2585832	9.2658470
28	18166.35	18473.73	101692.07	9.2592676	9.2665547
29	18194.95	18503.81	101697.54	9.2599509	9.2672613
30	18223.55	18533.90	101703.02	9.2606330	9.2679669

79 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang*
60	98480.77	567128.18	575877.05	9.9933515	10.7536812
59	98475.71	566165.09	574928.61	9.9933292	10.7529431
58	98470.65	565205.16	573983.33	9.9933068	10.7522061
57	98465.58	564248.38	573041.21	9.9932845	10.7514703
56	98460.50	563294.74	572102.23	9.9932621	10.7507357
55	98455.41	562344.21	571166.36	9.9932396	10.7500022
54	98450.31	561396.80	570233.60	9.9932171	10.7492699
53	98445.21	560452.47	569303.93	9.9931946	10.7485388
52	98440.10	559511.21	568377.34	9.9931720	10.7478088
51	98434.98	558573.02	567453.80	9.9931494	10.7470800
50	98429.85	557637.86	566533.31	9.9931268	10.7463523
49	98424.71	556705.74	565615.84	9.9931041	10.7456257
48	98419.56	555776.63	564701.40	9.9930814	10.7449003
47	98414.40	554850.52	563789.95	9.9930587	10.7441760
46	98409.24	553927.40	562881.48	9.9930359	10.7434528
45	98404.07	553007.24	561975.99	9.9930131	10.7427308
44	98398.89	552090.05	561073.45	9.9929902	10.7420099
43	98393.70	551175.79	560173.86	9.9929673	10.7412901
42	98388.50	550264.46	559277.19	9.9929444	10.7405715
41	98383.29	549356.04	558383.43	9.9929214	10.7398539
40	98378.08	548450.52	557492.58	9.9928984	10.7391375
39	98372.86	547547.88	556604.60	9.9928753	10.7384221
38	98367.63	546648.12	555719.50	9.9928522	10.7377079
37	98362.39	545751.21	554837.26	9.9928291	10.7369947
36	98357.14	544857.15	553957.86	9.9928059	10.7362828
35	98351.89	543965.92	553081.29	9.9927827	10.7355717
34	98346.63	543077.50	552207.54	9.9927595	10.7348618
33	98341.36	542191.88	551336.59	9.9927362	10.7341530
32	98336.08	541309.06	550468.43	9.9927129	10.7334453
31	98330.79	540429.01	549603.05	9.9926895	10.7327387
30	98325.49	539551.72	548740.43	9.9926661	10.7320331

10 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
30	18223.55	18533.90	101703.02	9.2606330	9.2679669
31	18252.15	18563.99	101708.51	9.2613141	9.2686714
32	18280.75	18594.08	101714.01	9.2619941	9.2693749
33	18309.35	18624.18	101719.52	9.2626729	9.2700772
34	18337.95	18654.28	101725.04	9.2633507	9.2707786
35	18366.54	18684.38	101730.56	9.2640274	9.2714788
36	18395.13	18714.49	101736.09	9.2647030	9.2721780
37	18423.73	18744.60	101741.63	9.2653775	9.2728762
38	18452.32	18774.71	101747.18	9.2660509	9.2735733
39	18480.91	18804.83	101752.74	9.2667232	9.2742694
40	18509.49	18834.95	101758.31	9 2673945	9.2749644
41	18538.08	18865.07	101763.89	9.2680647	9.2756584
42	18566 66	18895.20	101769.48	9.2687338	9.2763514
43	18595.24	18925.33	101775.08	9.2694019	9.2770434
44	18623.82	18955.46	101780.69	9.2700689	9.2777343
45	18652.40	18985.59	101786.31	9.2707348	9.2784242
46	18680.98	19015.73	101791.94	9.2713997	9.2791131
47	18709.56	19045.87	101797.58	9.2720635	9.2798009
48	18738.13	19076.02	101803.22	9.2727263	9.2804878
49	18766.70	19106.17	101808.87	9.2733880	9.2811736
50	18795.27	19136.32	101814.53	9.2740487	9.2818585
51	18823.84	19166.48	101820.20	9.2747083	9.2825423
52	18852.41	19196.64	101825.88	9 2753669	9.2832251
53	18880.98	19226.80	101831.57	9.2760245	9.2839070
54	18909.54	19256.96	101837.27	9.2766811	9.2845878
55	18938.11	19287.13	101842.98	9.2773366	9.2852677
56	18966.67	19317.30	101848.70	9.2779911	9.2859466
57	18995.23	19347.48	101854.43	9.2786445	9.2866245
58	19023.79	19377.66	101860.17	9.2792970	9.2873014
59	19052.34	19407.84	101865.92	9.2799484	9.2879773
60	19080.90	19438.03	101871.68	9.2805988	9.2886523

79 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
30	98325.49	539551.72	548740.43	9.9926661	10.7320331
29	98320.18	538677.18	547880.55	9.9926427	10.7313286
28	98314.87	537805.38	547023.42	9.9926192	10.7306251
27	98309.55	536936.30	546169.01	9.9925957	10.7299228
26	98304.22	536069.93	545317.31	9.9925722	10.7292214
25	98298.88	535206.26	544468.31	9.9925486	10.7285212
24	98293.53	534345.27	543621.99	9.9925250	10.7278220
23	98288.17	533486.96	542778.35	9.9925013	10.7271238
22	98282.81	532631.31	541937.37	9.9924776	10.7264267
21	98277.44	531778.30	541099.03	9.9924539	10.7257306
20	98272.06	530927.93	540263.33	9.9924301	10.7250356
19	98266.67	530080.18	539430.26	9.9924063	10.7243416
18	98261.27	529235.05	538599.79	9.9923824	10.7236486
17	98255.87	528392.51	537771.92	9.9923585	10.7229566
16	98250.46	527552.55	536946.64	9.9923346	10.7222657
15	98245.04	526715.17	536123.93	9.9923106	10.7215758
14	98239.61	525880.35	535303.79	9.9922866	10.7208869
13	98234.17	525048.09	534486.20	9.9922626	10.7201991
12	98228.72	524218.36	533671.14	9.9922385	10.7195122
11	98223.27	523391.16	532858.61	9.9922144	10.7188264
10	98217.81	522566.47	532048.60	9.9921902	10.7181415
9	98212.34	521744.28	531241.09	9.9921660	10.7174577
8	98206.86	520924.59	530436.08	9.9921418	10.7167749
7	98201.37	520107.38	529633.54	9.9921175	10.7160930
6	98195.87	519292.64	528833.47	9.9920932	10.7154122
5	98190.36	518480.35	528035.87	9.9920689	10.7147323
4	98184.85	517670.51	527240.70	9.9920445	10.7140534
3	98179.33	516863.11	526447.98	9.9920201	10.7133755
2	98173.80	516058.13	525657.68	9.9919956	10.7126986
1	98168.26	515255.57	524869.79	9.9919711	10.7120227
0	98162.71	514455.40	524084.31	9.9919466	10.7113477

11 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	19080.90	19438.03	101871.68	9.2805988	9.2886523
1	19109.45	19468.22	101877.44	9.2812483	9.2893263
2	19138.00	19498.41	101883.21	9.2818967	9.2899993
3	19166.55	19528.61	101888.99	9.2825441	9.2906713
4	19195.10	19558.81	101894.78	9.2831905	9.2913424
5	19223.65	19589.01	101900.58	9.2838359	9.2920126
6	19252.20	19619.22	101906.39	9.2844803	9.2926817
7	19280.74	19649.43	101912.21	9.2851237	9.2933500
8	19309.28	19679.64	101918.04	9.2857661	9.2940172
9	19337.82	19709.86	101923.88	9.2864076	9.2946836
10	19366.36	19740.08	101929.73	9.2870480	9.2953489
11	19394.90	19770.30	101935.59	9.2876875	9.2960134
12	19423.44	19800.53	101941.46	9.2883260	9.2966769
13	19451.97	19830.76	101947.34	9.2889636	9.2973395
14	19480.50	19861.00	101953.23	9.2896001	9.2980011
15	19509.03	19891.24	101959.12	9.2902357	9.2986618
16	19537.56	19921.48	101965.02	9.2908704	9.2993216
17	19566.09	19951.72	101970.93	9.2915040	9.2999804
18	19594.61	19981.97	101976.85	9.2921367	9.3006383
19	19623.14	20012.22	101982.78	9.2927685	9.3012954
20	19651.66	20042.48	101988.72	9.2933993	9.3019514
21	19680.18	20072.74	101994.67	9.2940291	9.3026066
22	19708.70	20103.00	102000.63	9.2946580	9.3032609
23	19737.22	20133.27	102006.60	9.2952859	9.3039143
24	19765.73	20163.54	102012.58	9.2959129	9.3045667
25	19794.25	20193.81	102018.57	9.2965390	9.3052183
26	19822.76	20224.09	102024.57	9.2971641	9.3058689
27	19851.27	20254.37	102030.58	9.2977883	9.3065187
28	19879.78	20284.65	102036.60	9.2984116	9.3071675
29	19908.29	20314.94	102042.63	9.2990339	9.3078155
30	19936.79	20345.23	102048.67	9.2996553	9.3084626

78 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	98162.71	514455.40	524084.31	9.9919466	10.7113477
59	98157.16	513657.63	523301.21	9.9919220	10.7106737
58	98151.60	512862.24	522520.50	9.9918974	10.7100007
57	98146.03	512069.21	521742.16	9.9918727	10.7093287
56	98140.45	511278.55	520966.18	9.9918480	10.7086576
55	98134.86	510490.24	520192.54	9.9918233	10.7079874
54	98129.26	509704.26	519421.25	9.9917986	10.7073183
53	98123.66	508920.61	518652.28	9.9917737	10.7066500
52	98118.05	508139.28	517885.63	9.9917489	10.7059828
51	98112.43	507360.25	517121.28	9.9917240	10.7053164
50	98106.80	506583.52	516359.24	9.9916991	10.7046511
49	98101.16	505809.07	515599.48	9.9916741	10.7039866
48	98095.51	505036.90	514841.99	9.9916492	10.7033231
47	98089.86	504267.00	514086.77	9.9916241	10.7026605
46	98084.20	503499.35	513333.81	9.9915990	10.7019989
45	98078.53	502733.95	512583.09	9.9915739	10.7013383
44	98072 85	501970.78	511834.61	9.9915488	10.7006784
43	98067.16	501209.84	511088.35	9.9915236	10.7000196
42	98061.46	500451.11	510344.31	9.9914984	10.6993617
41	98055.76	499694.59	509602.48	9.9914731	10.6987046
40	98050.05	498940.27	508862.84	9.9914478	10.6980486
39	98044.33	498188.13	508125.39	9.9914225	10.6973934
38	98038.60	497438.17	507390.12	9.991397	10.6967391
37	98032.86	496690.37	506657.01	9.9913717	10.6960857
36	98027.11	495944.74	505926.06	9.9913462	10.6954333
35	98021.36	495201.25	505197.26	9.9913207	10.6947817
34	98015.60	494459.90	504470.60	9.9912952	10.6941311
33	98009.83	493720.6[illegible]	503746.07	9.9912696	10.6934813
32	98004.05	492983.58	503023.67	9.9912440	10.6928325
31	97998.26	492248.59	502303.37	9.9912184	10.6921845
30	97992.47	491515.70	501585.17	9.9911927	10.6915374

11 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	19936.79	20345.23	102048.67	9.2996553	9.3084626
31	19965.30	20375.52	102054.71	9.3002758	9.3091088
32	19993.80	20405.82	102060.76	9.3008953	9.3097541
33	20022.30	20436.12	102066.82	9.3015140	9.3103985
34	20050.80	20466.43	102072.89	9.3021317	9.3110421
35	20079.30	20496.74	102078.97	9.3027485	9.3116848
36	20107.79	20527.05	102085.06	9.3033644	9.3123266
37	20136.29	20557.37	102091.16	9.3039794	9.3129675
38	20164.78	20587.69	102097.27	9.3045934	9.3136076
39	20193.27	20618.01	102103.39	9.3052066	9.3142468
40	20221.76	20648.34	102109.52	9.3058189	9.3148851
41	20250.24	20678.67	102115.66	9.3064303	9.3155226
42	20278.73	20709.00	102121.81	9.3070407	9.3161592
43	20307.21	20739.34	102127.97	9.3076503	9.3167950
44	20335.69	20769.68	102134.14	9.3082590	9.3174299
45	20364.17	20800.03	102140.32	9.3088668	9.3180640
46	20392.65	20830.38	102146.50	9.3094737	9.3186972
47	20421.13	20860.73	102152.69	9.3100798	9.3193295
48	20449.61	20891.09	102158.89	9.3106849	9.3199611
49	20478.08	20921.45	102165.10	9.3112892	9.3205918
50	20506.55	20951.81	102171.32	9.3118926	9.3212216
51	20535.02	20982.18	102177.55	9.3124951	9.3218506
52	20563.49	21012.55	102183.79	9.3130968	9.3224788
53	20591.95	21042.93	102190.04	9.3136976	9.3231061
54	20620.42	21073.31	102196.30	9.3142975	9.3237327
55	20648.88	21103.69	102202.57	9.3148965	9.3243584
56	20677.34	21134.07	102208.85	9.3154947	9.3249832
57	20705.80	21164.46	102215.14	9.3160921	9.3256073
58	20734.26	21194.85	102221.44	9.3166885	9.3262305
59	20762.71	21225.26	102227.75	9.3172841	9.3268529
60	20791.17	21255.65	102234.07	9.3178789	9.3274745

78 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Tang. Log.
30	97992.47	491515.70	501585.17	9.9911927	10.6915373
29	97986.67	490784.91	500869.07	9.9911670	10.6908912
28	97980.86	490056.20	500155.05	9.9911412	10.6902459
27	97975.04	489329.56	499443.11	9.9911154	10.6896015
26	97969.21	488624.99	498733.23	9.9910896	10.6889579
25	97963.37	487880.48	498025.41	9.9910637	10.6883152
24	97957.52	487162.01	497319.64	9.9910378	10.6876734
23	97951.67	486443.59	496615.91	9.9910119	10.6870325
22	97945.81	485727.19	495914.21	9.9909859	10.6863924
21	97939.94	485012.82	495214.53	9.9909598	10.6857532
20	97934.06	484300.45	494516.87	9.9909338	10.6851149
19	97928.17	483590.10	493821.20	9.9909077	10.6844774
18	97922.28	482881.74	493127.54	9.9908815	10.6838408
17	97916.38	482175.36	492435.86	9.9908553	10.6832050
16	97910.47	481470.96	491746.16	9.9908291	10.6825701
15	97904.55	480768.54	491058.44	9.9908029	10.6819360
14	97898.62	480068.08	490372.67	9.9907766	10.6813028
13	97892.68	479369.57	489688.86	9.9907502	10.6806705
12	97886.74	478673.00	489007.00	9.9907239	10.6800389
11	97880.79	477978.37	488327.07	9.9906974	10.6794082
10	97874.83	477285.67	487649.07	9.9906710	10.6787784
9	97868.86	476594.90	486972.99	9.9906445	10.6781494
8	97862.88	475906.03	486298.83	9.9906180	10.6775212
7	97856.89	475219.07	485626.57	9.9905914	10.6768939
6	97850.90	474534.01	484956.21	9.9905648	10.6762673
5	97844.90	473850.83	484287.74	9.9905382	10.6756416
4	97838.89	473169.54	483621.14	9.9905115	10.6750168
3	97832.87	472490.12	482956.43	9.9904848	10.6743927
2	97826.84	471812.56	482293.57	9.9904580	10.6737695
1	97820.80	471136.86	481632.58	9.9904312	10.6731471
0	97814.76	470463.01	480973.43	9.9904044	10.6725255

12 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	20791.17	21255.65	102234.07	9.3178789	9.3274745
1	20819.62	21286.06	102240.40	9.3184728	9.3280953
2	20848.07	21316.47	102246.73	9.3190659	9.3287153
3	20876.52	21346.88	102253.07	9.3196581	9.3293345
4	20904.97	21377.30	102259.42	9.3202495	9.3299528
5	20933.41	21407.72	102265.78	9.3208400	9.3305704
6	20961.86	21438.14	102272.15	9.3214297	9.3311872
7	20990.30	21468.57	102278.53	9.3220186	9.3318031
8	21018.74	21499.00	102284.92	9.3226066	9.3324183
9	21047.18	21529.44	102291.32	9.3231938	9.3330327
10	21075.61	21559.88	102297.73	9.3237802	9.3336463
11	21104.05	21590.32	102304.15	9.3243657	9.3342591
12	21132.48	21620.77	102310.58	9.3249505	9.3348711
13	21160.91	21651.22	102317.02	9.3255344	9.3354823
14	21189.34	21681.67	102323.47	9.3261174	9.3360927
15	21217.77	21712.13	102329.93	9.3266997	9.3367024
16	21246.19	21742.59	102336.40	9.3272811	9.3373113
17	21274.62	21773.06	102342.88	9.3278617	9.3379194
18	21303.04	21803.53	102349.37	9.3284416	9.3385267
19	21331.46	21834.00	102355.87	9.3290206	9.3391333
20	21359.88	21864.48	102362.38	9.3295988	9.3397391
21	21388.29	21894.96	102368.90	9.3301761	9.3403441
22	21416.71	21925.44	102375.43	9.3307527	9.3409484
23	21445.12	21955.93	102381.96	9.3313285	9.3415519
24	21473.53	21986.42	102388.50	9.3319035	9.3421546
25	21501.94	22016.92	102395.05	9.3324777	9.3427566
26	21530.35	22047.42	102401.61	9.3330511	9.3433578
27	21558.76	22077.93	102408.18	9.3336237	9.3439583
28	21587.16	22108.44	102414.76	9.3341955	9.3445580
29	21615.56	22138.95	102421.35	9.3347665	9.3451570
30	21643.96	22169.47	102427.95	9.3353368	9.3457552

77 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	97814.76	470463.01	480973.43	9.9904044	10.6725255
59	97808.71	469791.00	480316.13	9.9903775	10.6719047
58	97802.65	469120.83	479660.66	9.9903506	10.6712847
57	97796.58	468452.48	479007.02	9.9903237	10.6706655
56	97790.50	467785.95	478355.20	9.9902967	10.6700472
55	97784.41	467121.24	477705.19	9.9902697	10.6694296
54	97778.32	466458.32	477056.99	9.9902426	10.6688128
53	97772.22	465797.21	476410.58	9.9902155	10.6681969
52	97766.11	465137.88	475765.96	9.9901883	10.6675817
51	97759.99	464480.34	475123.12	9.9901612	10.6669673
50	97753.86	463824.57	474482.06	9.9901339	10.6663537
49	97747.73	463170.56	473842.77	9.9901067	10.6657409
48	97741.59	462518.32	473205.23	9.9900794	10.6651289
47	97735.44	461867.83	472569.45	9.9900521	10.6645177
46	97729.28	461219.08	471935.42	9.9900247	10.6639073
45	97723.11	460572.07	471303.13	9.9899973	10.6632976
44	97716.93	459926.80	470672.56	9.9899698	10.6626887
43	97710.75	459283.25	470043.72	9.9899423	10.6620806
42	97704.56	458641.41	469416.60	9.9899148	10.6614733
41	97698.36	458001.29	468791.19	9.9898873	10.6608667
40	97692.15	457362.87	468167.48	9.9898597	10.6602609
39	97685.93	456726.14	467545.48	9.9898320	10.6596559
38	97679.70	456091.11	466925.16	9.9898043	10.6590516
37	97673.47	455457.76	466306.52	9.9897766	10.6584481
36	97667.23	454826.08	465689.56	9.9897489	10.6578454
35	97660.98	454196.08	465074.27	9.9897211	10.6572434
34	97654.72	453567.73	464460.64	9.9896932	10.6566422
33	97648.45	452941.05	463848.67	9.9896654	10.6560417
32	97642.17	452316.01	463238.35	9.9896374	10.6554420
31	97535.89	451692.61	462629.67	9.9896095	10.6548430
30	97629.60	451070.85	462022.63	9.9895815	10.6542448

12 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	21643.96	22169.47	102427.95	9.3353368	9.3457552
31	21672.36	22199.99	102434.56	9.3359062	9.3463527
32	21700.76	22230.51	102441.18	9.3364749	9.3469494
33	21729.15	22261.04	102447.81	9.3370428	9.3475454
34	21757.54	22291.57	102454.45	9.3376099	9.3481407
35	21785.93	22322.11	102461.10	9.3381762	9.3487352
36	21814.32	22352.65	102467.76	9.3387418	9.3493290
37	21842.71	22383.19	102474.43	9.3393065	9.3499220
38	21871.10	22413.74	102481.11	9.3398706	9.3505143
39	21899.48	22444.29	102487.80	9.3404338	9.3511059
40	21927.86	22474.85	102494.49	9.3409963	9.3516968
41	21956.24	22505.41	102501.19	9.3415580	9.3522869
42	21984.62	22535.97	102507.90	9.3421190	9.3528763
43	22013.00	22566.54	102514.62	9.3426792	9.3534650
44	22041.37	22597.11	102521.35	9.3432386	9.3540530
45	22069.74	22627.69	102528.09	9.3437973	9.3546402
46	22098.11	22658.27	102534.84	9.3443552	9.3552267
47	22126.48	22688.85	102541.60	9.3449124	9.3558126
48	22154.85	22719.44	102548.37	9.3454688	9.3563977
49	22183.21	22750.03	102555.15	9.3460245	9.3569821
50	22211.58	22780.63	102561.94	9.3465794	9.3575658
51	22239.94	22811.23	102568.74	9.3471336	9.3581487
52	22268.30	22841.83	102575.55	9.3476870	9.3587310
53	22296.66	22872.44	102582.37	9.3482397	9.3593126
54	22325.01	22903.05	102589.20	9.3487917	9.3598935
55	22353.37	22933.67	102596.04	9.3493429	9.3604736
56	22381.72	22964.29	102602.89	9.3498934	9.3610531
57	22410.07	22994.92	102609.75	9.3504432	9.3616319
58	22438.41	23025.55	102616.62	9.3509922	9.3622100
59	22466.76	23056.18	102623.50	9.3515405	9.3627874
60	22495.11	23086.82	112630.39	9.3520880	9.3633641

77 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	97629.60	451070.85	462022.63	9.9895815	10.6542448
29	97623.30	450450.72	461417.22	9.9895535	10.6536473
28	97616.99	449832.21	460813.43	9.9895254	10.6530506
27	97610.67	449215.32	460211.26	9.9894973	10.6524546
26	97604.35	448600.04	459610.70	9.9894692	10.6518593
25	97598.02	447986.36	459011.74	9.9894410	10.6512648
24	97591.68	447374.28	458414.39	9.9894128	10.6506710
23	97585.33	446763.79	457818.62	9.9893845	10.6500780
22	97578.97	446154.89	457224.44	9.9893562	10.6494857
21	97572.60	445547.56	456631.83	9.9893279	10.6488941
20	97566.23	444941.81	456040.80	9.9892995	10.6483032
19	97559.85	444337.62	455451.34	9.9892711	10.6477131
18	97553.46	443734.99	454863.44	9.9892427	10.6471237
17	97547.06	443133.92	454277.09	9.9892142	10.6465350
16	97540.65	442534.39	453692.29	9.9891856	10.6459470
15	97534.23	441936.41	453109.03	9.9891571	10.6453598
14	97527.81	441339.96	452527.30	9.9891285	10.6447733
13	97521.38	440745.04	451947.11	9.9890998	10.6441874
12	97514.94	440151.64	451368.44	9.9890711	10.6436023
11	97508.49	439559.76	450791.29	9.9890424	10.6430179
10	97502.03	438969.40	450215.65	9.9890137	10.6424342
9	97495.56	438380.54	449641.52	9.9889849	10.6418513
8	97489.09	437793.17	449068.89	9.9889560	10.6412690
7	97482.61	437207.31	448497.75	9.9889271	10.6406874
6	97476.12	436622.93	447928.10	9.9888982	10.6401065
5	97469.62	436040.03	447359.93	9.9888693	10.6395264
4	97463.11	435458.61	446793.24	9.9888403	10.6389469
3	97456.60	434878.66	446228.03	9.9888113	10.6383681
2	97450.08	434300.18	445664.28	9.9887822	10.6377900
1	97443.55	433723.16	445101.98	9.9887531	10.6372126
0	97437.01	433147.59	444541.15	9.9887239	10.6366359

13 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
0	22495.11	23086.82	102630.39	9.3520880	9.3633641
1	22523.45	23117.46	102637.29	9.3526349	9.3639401
2	22551.79	23148.11	102644.20	9.3531810	9.3645155
3	22580.13	23178.76	102651.12	9.3537264	9.3650901
4	22608.46	23209.41	102658.05	9.3542710	9.3656641
5	22636.80	23240.07	102664.99	9.3548150	9.3662374
6	22665.13	23270.73	102671.94	9.3553582	9.3668100
7	22693.46	23301.40	102678.90	9.3559007	9.3673819
8	22721.79	23332.07	102685.87	9.3564426	9.3679532
9	22750.12	23362.74	102692.84	9.3569836	9.3685238
10	22778.44	23393.42	102699.82	9.3575240	9.3690937
11	22806.77	23424.10	102706.81	9.3580637	9.3696629
12	22835.09	23454.79	102713.81	9.3586027	9.3702315
13	22863.41	23485.48	102720.82	9.3591409	9.3707994
14	22891.72	23516.17	102727.84	9.3596785	9.3713667
15	22920.04	23546.87	102734.87	9.3602154	9.3719333
16	22948.35	23577.58	102741.91	9.3607515	9.3724992
17	22976.66	23608.29	102748.96	9.3612870	9.3730645
18	23004.97	23639.00	102756.02	9.3618217	9.3736291
19	23033.28	23669.72	102763.09	9.3623558	9.3741930
20	23061.59	23700.44	102770.17	9.3628892	9.3747563
21	23089.89	23731.16	102777.26	9.3634219	9.3753190
22	23118.19	23761.89	102784.36	9.3639539	9.3758810
23	23146.49	23792.62	102791.47	9.3644852	9.3764423
24	23174.79	23823.36	102798.59	9.3650158	9.3770030
25	23203.09	23854.10	102805.72	9.3655458	9.3775631
26	23231.38	23884.85	102812.86	9.3660750	9.3781225
27	23259.67	23915.60	102820.01	9.3666036	9.3786813
28	23287.96	23946.35	102827.17	9.3671315	9.3792394
29	23316.25	23977.11	102834.34	9.3676587	9.3797969
30	23344.54	24007.87	102841.52	9.3681853	9.3803537

76 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	97437.01	433147.59	444541.15	9.9887239	10.6366359
59	97430.46	432573.47	443981.76	9.9886947	10.6360599
58	97423.90	432000.79	443423.82	9.9886655	10.6354845
57	97417.34	431429.55	442867.31	9.9886363	10.6349099
56	97410.77	430859.74	442312.24	9.9886070	10.6343359
55	97404.19	430291.36	441758.59	9.9885776	10.6337626
54	97397.60	429724.40	441206.37	9.9885482	10.6331900
53	97391.00	429158.85	440655.56	9.9885188	10.6326181
52	97384.39	428594.72	440106.16	9.9884894	10.6320468
51	97377.78	428031.99	439558.17	9.9884599	10.6314762
50	97371.16	427470.66	439011.58	9.9884303	10.6309063
49	97364.53	426910.72	438466.38	9.9884008	10.6303371
48	97357.89	426352.18	437922.57	9.9883712	10.6297685
47	97351.24	425795.01	437380.15	9.9883415	10.6292006
46	97344.58	425239.23	436839.10	9.9883118	10.6286333
45	97337.92	424684.82	436299.43	9.9882821	10.6280667
44	97331.25	424131.77	435761.13	9.9882523	10.6275008
43	97324.57	423580.09	435224.19	9.9882225	10.6269355
42	97317.88	423029.77	434688.61	9.9881927	10.6263709
41	97311.18	422480.80	434154.38	9.9881628	10.6258070
40	97304.48	421933.18	433621.50	9.9881329	10.6252437
39	97297.77	421386.90	433089.96	9.9881029	10.6246810
38	97291.05	420841.96	432559.77	9.9880729	10.6241190
37	97284.32	420298.35	432030.90	9.9880429	10.6235577
36	97277.58	419756.06	431503.36	9.9880128	10.6229970
35	97270.84	419215.10	430977.15	9.9879827	10.6224369
34	97264.09	418675.46	430452.25	9.9879525	10.6218775
33	97257.33	418137.13	429928.67	9.9879223	10.6213187
32	97250.56	417600.11	429406.40	9.9878921	10.6207606
31	97243.78	417064.40	428885.43	9.9878618	10.6202031
30	97236.99	416529.98	428365.76	9.9878315	10.6196463

13 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	23344.54	24007.87	102841.52	9.3681853	9.3803537
31	23372.82	24038.64	102848.71	9.3687111	9.3809100
32	23401.10	24069.41	102855.91	9.3692363	9.3814655
33	23429.38	24100.19	102863.12	9.3697608	9.3820205
34	23457.66	24130.97	102870.34	9.3702847	9.3825748
35	23485.94	24161.76	102877.57	9.3708079	9.3831285
36	23514.21	24192.55	102884.81	9.3713304	9.3836816
37	23542.48	24223.34	102892.06	9.3718523	9.3842340
38	23570.75	24254.14	102899.32	9.3723735	9.3847858
39	23599.02	24284.94	102906.58	9.3728940	9.3853370
40	23627.29	24315.75	102913.85	9.3734139	9.3858876
41	23655.55	24346.56	102921.13	9.3739331	9.3864376
42	23683.81	24377.37	102928.42	9.3744517	9.3869869
43	23712.07	24408.19	102935.72	9.3749696	9.3875356
44	23740.33	24439.01	102943.03	9.3754868	9.3880837
45	23768.59	24469.84	102950.35	9.3760034	9.3886312
46	23796.84	24500.67	102957.68	9.3765194	9.3891781
47	23825.10	24531.51	102965.02	9.3770347	9.3897244
48	23853.35	24562.35	102972.37	9.3775493	9.3902700
49	23881.59	24593.20	102979.73	9.3780633	9.3908151
50	23909.84	24624.05	102987.10	9.3785767	9.3913595
51	23938.08	24654.91	102994.48	9.3790894	9.3919034
52	23966.33	24685.77	103001.87	9.3796015	9.3924466
53	23994.57	24716.63	103009.27	9.3801129	9.3929893
54	24022.80	24747.50	103016.68	9.3806237	9.3935313
55	24051.04	24778.37	103024.10	9.3811339	9.3940727
56	24079.27	24809.25	103031.53	9.3816434	9.3946136
57	24107.51	24840.13	103038.97	9.3821523	9.3951538
58	24135.74	24871.02	103046.42	9.3826605	9.3956935
59	24163.96	24901.91	103053.88	9.3831682	9.3962326
60	24192.19	24932.80	103061.35	9.3836752	9.3967711

76 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	97236.99	416529.98	428365.76	9.9878315	10.6196463
29	97230.19	415996.85	427847.38	9.9878012	10.6190900
28	97223.39	415465.01	427330.29	9.9877708	10.6185345
27	97216.58	414934.46	426814.49	9.9877404	10.6179795
26	97209.76	414405.19	426299.96	9.9877099	10.6174252
25	97202.93	413877.19	425786.71	9.9876794	10.6168715
24	97196.09	413350.46	425274.74	9.9876488	10.6163184
23	97189.25	412824.99	424764.02	9.9876183	10.6157660
22	97182.40	412300.79	424254.57	9.9875876	10.6152142
21	97175.54	411777.84	423746.37	9.9875570	10.6146630
20	97168.67	411256.14	423239.43	9.9875263	10.6141124
19	97161.79	410735.69	422733.73	9.9874955	10.6135624
18	97154.91	410216.49	422229.28	9.9874648	10.6130131
17	97148.02	409698.52	421726.06	9.9874339	10.6124644
16	97141.12	409181.78	421224.08	9.9874031	10.6119163
15	97134.21	408666.27	420723.33	9.9873722	10.6113688
14	97127.29	408151.99	420223.80	9.9873413	10.6108219
13	97120.36	407638.92	419725.49	9.9873103	10.6102756
12	97113.43	407127.07	419228.40	9.9872793	10.6097300
11	97106.49	406616.43	418732.52	9.9872482	10.6091849
10	97099.54	406107.00	418237.85	9.9872171	10.6086405
9	97092.58	405598.77	417744.38	9.9871860	10.6080966
8	97085.61	405091.74	417252.10	9.9871549	10.6075534
7	97078.63	404585.90	416761.02	9.9871236	10.6070107
6	97071.65	404081.25	416271.14	9.9870924	10.6064687
5	97064.66	403577.79	415782.43	9.9870611	10.6059273
4	97057.66	403075.50	415294.91	9.9870298	10.6053864
3	97050.65	402574.40	414808.56	9.9869984	10.6048462
2	97043.63	402074.46	414323.39	9.9869670	10.6043065
1	97036.60	401575.70	413839.39	9.9869356	10.6037674
0	97029.57	401078.09	413356.55	9.9869041	10.6032289

14 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	24192.19	24932.80	103061.35	9.3836752	9.3967711
1	24220.41	24963.70	103068.83	9.3841815	9.3973089
2	24248.63	24994.60	103076.32	9.3846873	9.3978463
3	24276.85	25025.51	103083.82	9.3851924	9.3983830
4	24305.07	25056.42	103091.33	9.3856969	9.3989191
5	24333.29	25087.34	103098.85	9.3862008	9.3994547
6	24361.50	25118.26	103106.38	9.3867040	9.3999896
7	24389.71	25149.19	103113.92	9.3872067	9.4005240
8	24417.92	25180.12	103121.47	9.3877087	9.4010578
9	24446.13	25211.06	103129.03	9.3882101	9.4015910
10	24474.33	25242.00	103136.60	9.3887109	9.4021237
11	24502.54	25272.94	103144.18	9.3892111	9.4026558
12	24530.74	25303.89	103151.77	9.3897106	9.4031873
13	24558.94	25334.84	103159.36	9.3902096	9.4037182
14	24587.13	25365.80	103166.97	9.3907079	9.4042486
15	24615.33	25396.76	103174.59	9.3912057	9.4047784
16	24643.52	25427.73	103182.22	9.3917028	9.4053076
17	24671.71	25458.70	103189.85	9.3921993	9.4058363
18	24699.90	25489.68	103197.50	9.3926952	9.4063644
19	24728.09	25520.66	103205.16	9.3931905	9.4068919
20	24756.27	25551.65	103212.82	9.3936852	9.4074189
21	24784.45	25582.64	103220.50	9 3941794	9.4079453
22	24812.63	25613.63	103228.18	9.3946729	9.4084712
23	24840.81	25644.63	103235.88	9.3951658	9.4089965
24	24868.99	25675.63	103243.59	9.3956581	9.4095212
25	24897.16	25706.64	103251.30	9.3961499	9.4100454
26	24925.33	25737.66	103259.03	9.3966410	9.4105690
27	24953.50	25768.68	103266.76	9.3971315	9.4110921
28	24981.67	25799.70	103274 51	9.3976215	9.4116146
29	25009.84	25830.73	103282.27	9.3981109	9.4121366
30	25038.00	25861.76	103290.03	9.3985996	9.4126581

75 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang
60	97029.57	401078.09	413356.55	9.9869041	10.6032289
59	97022.53	400581.65	412874.87	9.9868726	10.6026911
58	97015.48	400086.36	412394.35	9.9868410	10.6021537
57	97008.42	399592.23	411914.98	9.9868094	10.6016170
56	97001.35	399099.24	411436.75	9.9867778	10.6010809
55	96994.28	398607.39	410959.67	9.9867461	10.6005453
54	96987.20	398116.69	410483.74	9.9867144	10.6000104
53	96980.11	397627.12	410008.93	9.9866827	10.5994760
52	96973.01	397138.68	409535.26	9.9866509	10.5989422
51	96965.90	396651.37	409062.72	9.9866191	10.5984090
50	96958.79	396165.18	408591.30	9.9865872	10.5978763
49	96951.67	395680.11	408121.00	9.9865553	10.5973442
48	96944.54	395196.15	407651.81	9.9865233	10.5968127
47	96937.40	394713.31	407183.74	9.9864913	10.5962818
46	96930.25	394231.57	406716.77	9.9864593	10.5957514
45	96923.09	393750.94	406250.91	9.9864273	10.5952216
44	96915.92	393271.41	405786.15	9.9863952	10.5946924
43	96908.75	392792.97	405322.49	9.9863630	10.5941637
42	96901.57	392315.63	404859.92	9.9863308	10.5936356
41	96894.38	391839.37	404398.44	9.9862986	10.5931081
40	96887.18	391364.20	403938.04	9.9862663	10.5925811
39	96879.98	390890.11	403478.72	9.9862340	10.5920547
38	96872.77	390417.10	403020.48	9.9862017	10.5915288
37	96865.55	389945.16	402563.32	9.9861693	10.5910035
36	96858.32	389474.29	402107.22	9.9861369	10.5904788
35	96851.08	389004.48	401652.19	9.9861045	10.5899546
34	96843.83	388535.74	401198.23	9.9860720	10.5894310
33	96836.57	388068.05	400745.32	9.9860394	10.5889079
32	96829.31	387601.42	400293.47	9.9860069	10.5883854
31	96822.04	387135.84	399842.67	9.9859742	10.5878634
30	96814.76	386671.31	399392.92	9.9859416	10.5873419

14 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
30	25038.00	25861.76	103290.03	9.3985996	9.4126581
31	25066.16	25892.80	103297.81	9.3990878	9.4131789
32	25094.32	25923.84	103305.59	9.3995754	9.4136993
33	25122.48	25954.88	103313.39	9.4000625	9.4142191
34	25150.63	25985.93	103321.19	9.4005489	9.4147383
35	25178.79	26016.99	103329.01	9.4010348	9.4152570
36	25206.94	26048.05	103336.83	9.4015201	9.4157752
37	25235.08	26079.11	103344.67	9.4020048	9.4162928
38	25263.23	26110.18	103352.51	9.4024889	9.4168099
39	25291.37	26141.26	103360.37	9.4029734	9.4173265
40	25319.52	26172.34	103368.23	9.4034554	9.4178425
41	25347.66	26203.42	103376.11	9.4039378	9.4183580
42	25375.79	26234.51	103383.99	9.4044196	9.4188729
43	25403.93	26265.60	103391.88	9.4049009	9.4193874
44	25432.06	26296.70	103399.79	9.4053816	9.4199013
45	25460.19	26327.80	103407.70	9.4058617	9.4204146
46	25488.32	26358.91	103415.63	9.4063413	9.4209275
47	25516.45	26390.02	103423.56	9.4068203	9.4214398
48	25544.58	26421.14	103431.51	9.4072987	9.4219515
49	25572.70	26452.26	103439.46	9.4077766	9.4224628
50	25600.82	26483.39	103447.43	9.4082539	9.4229735
51	25628.94	26514.52	103455.40	9.4087306	9.4234838
52	25657.05	26545.66	103463.38	9 4092068	9.4239935
53	25685.17	26576.80	103471.38	9.4096824	9.4245026
54	25713.28	26607.94	103479.38	9.4101575	9.4250113
55	25741.39	26639.09	103487.40	9.4106320	9.4255194
56	25769.50	26670.25	103495.42	9.4111059	9.4260271
57	25797.60	26701.41	103503.46	9.4115793	9.4265342
58	25825.70	26732.57	103511.50	9.4120522	9.4270408
59	25853.81	26763.74	103519.55	9.4125245	9.4275469
60	25881.90	26794.92	103527.62	9.4129962	9.4280525

75 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	96814.76	386671.31	399392.92	9.9859416	10.5873419
29	96807.47	386207.82	398944.21	9.9859089	10.5868211
28	96800.18	385745.37	398496.54	9.9858762	10.5863007
27	96792.88	385283.96	398049.91	9.9858434	10.5857809
26	96785.57	384823.58	397604.31	9.9858106	10.5852617
25	96778.25	384364.24	397159.75	9.9857777	10.5847430
24	96770.92	383905.91	396716.21	9.9857449	10.5842248
23	96763.58	383448.61	396273.69	9.9857119	10.5837072
22	96756.23	382992.33	395832.19	9.9856790	10.5831901
21	96748.88	382537.07	395391.71	9.9856460	10.5826735
20	96741.52	382082.81	394952.24	9.9856129	10.5821575
19	96734.15	381629.57	394513.79	9.9855798	10.5816420
18	96726.77	381177.33	394076.33	9.9855467	10.5811271
17	96719.38	380726.06	393639.88	9.9855135	10.5806126
16	96711.99	380275.85	393204.43	9.9854803	10.5800987
15	96704.59	379826.61	392769.97	9.9854471	10.5795854
14	96697.18	379378.35	392336.51	9.9854138	10.5790725
13	96689.76	378931.09	391904.03	9.9853805	10.5785602
12	96682.33	378484.81	391472.54	9.9853471	10.5780485
11	96674.90	378039.51	391042.03	9.9853138	10.5775372
10	96667.46	377595.19	390612.50	9.9852803	10.5770265
9	96660.01	377151.85	390183.95	9.9852468	10.5765162
8	96652.55	376709.47	389756.37	9.9852133	10.5760065
7	96645.08	376268.07	389329.76	9.9851798	10.5754974
6	96637.60	375827.63	388904.11	9.9851462	10.5749887
5	96630.12	375388.15	388479.43	9.9851125	10.5744806
4	96622.63	374949.63	388055.70	9.9850789	10.5739729
3	96615.13	374512.07	387632.93	9.9850452	10.5734658
2	96607.62	374075.46	387211.12	9.9850114	10.5729592
1	96600.10	373639.80	386790.25	9.9849776	10.5724531
0	96592.58	373205.08	386370.33	9.9849438	10.5719475

15 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	25881.90	26794.92	103527.62	9.4129962	9.4280525
1	25910.00	26826.10	103535.69	9.4134674	9.4285575
2	25938.10	26857.28	103543.78	9.4139381	9.4290621
3	25966.19	26888.47	103551.87	9.4144082	9.4295661
4	25994.28	26919.67	103559.98	9.4148778	9.4300697
5	26022.37	26950.87	103568.09	9.4153468	9.4305727
6	26050.45	26982.07	103576.21	9.4158152	9.4310753
7	26078.53	27013.28	103584.35	9.4162832	9.4315773
8	26106.61	27044.49	103592.49	9.4167506	9.4320789
9	26134.69	27075.71	103600.65	9.4172174	9.4325799
10	26162.77	27106.93	103608.81	9.4176837	9.4330804
11	26190.85	27138.16	103616.99	9.4181495	9.4335805
12	26218.92	27169.40	103625.17	9.4186148	9.4340800
13	26246.99	27200.64	103633.37	9.4190795	9.4345791
14	26275.06	27231.88	103641.57	9.4195436	9.4350776
15	26303.12	27263.13	103649.79	9.4200073	9.4355757
16	26331.18	27294.38	103658.01	9.4204704	9.4360733
17	26359.24	27325.64	103666.25	9.4209330	9.4365704
18	26387.30	27356.90	103674.49	9.4213950	9.4370670
19	26415.36	27388.17	103682.75	9.4218566	9.4375631
20	26443.42	27419.44	103691.01	9.4223176	9.4380587
21	26471.47	27450.72	103699.29	9.4227780	9.4385538
22	26499.52	27482.01	103707.57	9.4232380	9.4390485
23	26527.57	27513.30	103715.87	9.4236974	9.4395426
24	26555.61	27544.59	103724.17	9.4241563	9.4400363
25	26583.65	27575.89	103732.49	9.4246147	9.4405295
26	26611.69	27607.19	103740.82	9.4250726	9.4410222
27	26639.73	27638.50	103749.15	9.4255299	9.4415145
28	26667.77	27669.81	103757.50	9.4259867	9.4420062
29	26695.81	27701.13	103765.85	9.4264430	9.4424975
30	26723.84	27732.45	103774.22	9.4268988	9.4429883

74 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	96592.58	373205.08	386370.33	9.9849438	10.5719475
59	96585.05	372771.31	385951.35	9.9849099	10.5714425
58	96577.51	372338.47	385533.32	9.9848760	10.5709379
57	96569.96	371906.58	385116.22	9.9848420	10.5704339
56	96562.40	371475.61	384700.05	9.9848081	10.5699303
55	96554.83	371045.58	384284.82	9.9847740	10.5694273
54	96547.26	370616.48	383870.51	9.9847400	10.5689247
53	96539.68	370188.30	383457.13	9.9847059	10.5684227
52	96532.09	369761.03	383044.67	9.9846717	10.5679211
51	96524.49	369334.59	382633.13	9.9846375	10.5674201
50	96516.88	368909.27	382222.51	9.9846033	10.5669196
49	96509.27	368484.75	381812.80	9.9845690	10.5664195
48	96501.65	368061.15	381403.99	9.9845347	10.5659200
47	96494.02	367638.45	380996.10	9.9845004	10.5654209
46	96486.38	367216.65	380589.11	9.9844660	10.5649224
45	96478.73	366795.75	380183.01	9.9844316	10.5644243
44	96471.07	366375.75	379777.82	9.9843971	10.5639267
43	96463.41	365956.65	379373.52	9.9843626	10.5634296
42	96455.74	365538.44	378970.11	9.9843281	10.5629330
41	96448.06	365121.11	378567.60	9.9842935	10.5624369
40	96440.37	364704.67	378165.96	9.9842589	10.5619413
39	96432.67	364289.11	377765.22	9.9842242	10.5614462
38	96424.97	363874.44	377365.35	9.9841895	10.5609515
37	96417.26	363460.64	376966.36	9.9841548	10.5604574
36	96409.54	363047.71	376568.24	9.9841200	10.5599637
35	96401.81	362635.66	376171.00	9.9840852	10.5594705
34	96394.07	362224.47	375774.62	9.9840503	10.5580778
33	96386 33	361814.15	375379.11	9.9840154	10.5584855
32	96378.58	361404.69	374984.47	9.9839805	10.5579938
31	96370.82	360996.09	374590.68	9.9839455	10.5575025
30	96363.05	360588.3[illegible]	374197.75	9.9839105	10.5570117

15 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	26723.84	27732.45	103774.22	9.4268988	9.4429883
31	26751.87	27763.78	103782.60	9.4273541	9.4434786
32	26779.89	27795.12	103790.98	9.4278089	9.4439685
33	26807.92	27826.46	103799.38	9.4282631	9.4444579
34	26835.94	27857.80	103807.79	9.4287169	9.4449468
35	26863.96	27889.15	103816.21	9.4291701	9.4454352
36	26891.98	27920.50	103824.63	9.4296228	9.4459232
37	26920.00	27951.86	103833.07	9.4300750	9.4464107
38	26948.01	27983.22	103841.52	9.4305267	9.4468978
39	26976.02	28014.59	103849.98	9.4309779	9.4473843
40	27004.03	28045.97	103858.44	9.4314286	9.4478704
41	27032.04	28077.35	103866.92	9.4318788	9.4483561
42	27060.04	28108.73	103875.41	9.4323285	9.4488413
43	27088.05	28140.12	103883.91	9.4327777	9.4493260
44	27116.05	28171.52	103892.42	9.4332264	9.4498102
45	27144.04	28202.92	103900.94	9.4336746	9.4502940
46	27172.04	28234.32	103909.47	9.4341223	9.4507774
47	27200.03	28265.73	103918.00	9.4345694	9.4512602
48	27228.02	28297.15	103926.55	9.4350161	9.4517427
49	27256.01	28328.57	103935.11	9.4354623	9.4522246
50	27284.00	28359.99	103943.68	9.4359080	9.4527061
51	27311.98	28391.42	103958.26	9.4363532	9.4531872
52	27339.96	28422.86	103960.85	9.4367980	9.4536678
53	27367.94	28454.30	103969.45	9.4372422	9.4541479
54	27395.92	28485.75	103978.06	9.4376859	9.4546276
55	27423.90	28517.20	103986.69	9.4381292	9.4551069
56	27451.87	28548.66	103995.32	9.4385719	9.4555857
57	27479.84	28580.12	104003.96	9.4390142	9.4560641
58	27507.81	28611.59	104012.61	9.4394560	9.4565420
59	27535.78	28643.06	104021.27	9.4398973	9.4570194
60	27553.74	28674.54	104029.94	9.4403381	9.4574964

74 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Tang. Log
30	96363.05	360588.35	374197.75	9.9839105	10.5570117
29	96355.27	360181.46	373805.68	9.9838755	10.5565214
28	96347.48	359775.43	373414.46	9.9838404	10.5560315
27	96339.69	359370.24	373024.09	9.9838052	10.5555421
26	96331.89	358965.90	372634.57	9.9837701	10.5550532
25	96324.08	358562.41	372245.89	9.9837348	10.5545648
24	96316.26	358159.75	371858.05	9.9836996	10.5540768
23	96308.43	357757.94	371471.05	9.9836643	10.5535893
22	96300.59	357356.96	371084.89	9.9836290	10.5531022
21	96292.75	356956.81	370699.56	9.9835936	10.5526157
20	96284.90	356557.49	370315.06	9.9835582	10.5521296
19	96277.04	356159.00	369931.39	9.9835227	10.5516439
18	96269.17	355761.33	369548.54	9.9834872	10.5511587
17	96261.30	355364.49	369166.52	9.9834517	10.5506740
16	96253.42	354968.46	368785.32	9.9834161	10.5501898
15	96245.52	354573.25	368404.93	9.9833805	10.5497060
14	96237.62	354178.86	368025.36	9.9833449	10.5492226
13	96229.72	353785.28	367646.60	9.9833092	10.5487398
12	96221.80	353392.51	367268.65	9.9832735	10.5482573
11	96213.87	353000.54	366891.51	9.9832377	10.5477754
10	96205.94	352609.38	366515.18	9.9832019	10.5472939
9	96198.00	352219.02	366139.64	9.9831661	10.5468128
8	96190.05	351829.46	365764.91	9.9831302	10.5463322
7	96182.09	351440.70	365390.97	9.9830942	10.5458521
6	96174.13	351052.73	365017.83	9.9830583	10.5453724
5	96166.16	350665.55	364645.48	9.9830223	10.5448931
4	96158.18	350279.16	364273.92	9.9829862	10.5444143
3	96150.19	349893.56	363903.15	9.9829501	10.5439359
2	96142.19	349508.74	363533.16	9.9829140	10.5434580
1	96134.18	349124.70	363163.95	9.9828778	10.5429806
0	96126.17	348741.44	362795.53	9.9828416	10.5425036

16 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
0	27563.74	28674.54	104029.94	9.4403381	9.4574964
1	27591.70	28706.02	104038.63	9.4407784	9.4579730
2	27619.65	28737.51	104047.32	9.4412182	9.4584491
3	27647.61	28769.00	104056.02	9.4416576	9.4589248
4	27675.56	28800.50	104064.73	9.4420965	9.4594001
5	27703.52	28832.01	104073.46	9.4425349	9.4598749
6	27731.47	28863.52	104082.19	9.4429728	9.4603492
7	27759.41	28895.03	104090.94	9.4434103	9.4608232
8	27787.36	28926.55	104099.69	9.4438472	9.4612967
9	27815.30	28958.08	104108.45	9.4442837	9.4617697
10	27843.24	28989.61	104117.23	9.4447197	9.4622423
11	27871.18	29021.14	104126.01	9.4451553	9.4627145
12	27899.11	29052.68	104134.81	9.4455904	9.4631863
13	27927.04	29084.23	104143.62	9.4460250	9.4636576
14	27954.97	29115.78	104152.43	9.4464591	9.4641285
15	27982.90	29147.34	104161.26	9.4468927	9.4645990
16	28010.83	29178.90	104170.09	9.4473259	9.4650690
17	28038.75	29210.47	104178.94	9.4477586	9.4655386
18	28066.67	29242.05	104187.80	9.4481909	9.4660078
19	28094.59	29273.63	104196.67	9.4486227	9.4664765
20	28122.51	29305.21	104205.54	9.4490540	9.4669448
21	28150.42	29336.80	104214.43	9.4494849	9.4674127
22	28178.33	29368.39	104223.33	9.4499153	9.4678802
23	28206.24	29399.99	104232.24	9.4503452	9.4683473
24	28234.15	29431.60	104241.16	9.4507747	9.4688139
25	28262.05	29463.21	104250.09	9.4512037	9.4692801
26	28289.95	29494.83	104259.03	9.4516322	9.4697459
27	28317.85	29526.45	104267.98	9.4520603	9.4702112
28	28345.75	29558.08	104276.94	9.4524879	9.4706762
29	28373.64	29589.71	104285.91	9.4529151	9.4711407
30	28401.53	29621.35	104294.89	9.4533418	9.4716048

73 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
60	96126.17	348741.44	362795.53	9.9828416	10.5425036
59	96118.15	348358.96	362427.88	9.9828054	10.5420270
58	96110.12	347977.26	362061.01	9.9827691	10.5415509
57	96102.08	347596.32	361694.90	9.9827328	10.5410752
56	96094.03	347216.16	361329.57	9.9826964	10.5405999
55	96085.98	346836.76	360965.01	9.9826600	10.5401251
54	96077.92	346458.13	360601.21	9.9826236	10.5396508
53	96069.84	346080.26	360238.18	9.9825871	10.5391768
52	96061.77	345703.15	359875.90	9.9825506	10.5387033
51	96053.68	345326.79	359514.39	9.9825140	10.5382303
50	96045.58	344951.20	359153.63	9.9824774	10.5377577
49	96037.48	344576.35	358793.62	9.9824408	10.5372855
48	96029.37	344202.26	358434.37	9.9824041	10.5368137
47	96021.25	343828.91	358075.86	9.9823674	10.5363424
46	96013.12	343456.31	357718.10	9.9823306	10.5358715
45	96004.99	343084.46	357361.08	9.9822938	10.5354010
44	95996.84	342713.34	357004.81	9.9822569	10.5349310
43	95988.69	342342.97	356649.28	9.9822201	10.5344614
42	95980.53	341973.33	356294.48	9.9821831	10.5339922
41	95972.36	341604.43	355940.42	9.9821462	10.5335235
40	95964.18	341236.26	355587.10	9.9821092	10.5330552
39	95956.00	340868.82	355234.50	9.9820721	10.5325873
38	95947.81	340502.10	354882.63	9.9820351	10.5321198
37	95939.61	340136.12	354531.49	9.9819979	10.5316527
36	95931.40	339770.85	354181.07	9.9819608	10.5311861
35	95923.18	339406.31	353831.38	9.9819236	10.5307199
34	95914.96	339042.49	353482.40	9.9818863	10.5302541
33	95906.72	338679.38	353134.14	9.9818490	10.5297888
32	95898.48	338316.99	352786.60	9.9818117	10.5293238
31	95890.23	337955.31	352439.77	9.9817744	10.5288593
30	95881.97	337594.34	352093.65	9.9817370	10.5283952

16 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	28401.53	29621.35	104294.89	9.4533418	9.4716048
31	28429.42	29652.99	104303.88	9.4537681	9.4720685
32	28457.31	29684.64	104312.89	9.4541939	9.4725318
33	28485.20	29716.30	104321.90	9.4546192	9.4729947
34	28513.08	29747.96	104330.92	9.4550441	9.4734571
35	28540.96	29779.62	104339.95	9.4554686	9.4739192
36	28568.84	29811.29	104349.00	9.4558926	9.4743808
37	28596.72	29842.97	104358.05	9.4563161	9.4748421
38	28624.58	29874.65	104367.12	9.4567392	9.4753029
39	28652.45	29906.34	104376.19	9.4571618	9.4757633
40	28680.32	29938.03	104385.28	9.4575840	9.4762233
41	28708.19	29969.73	104394.37	9.4580058	9.4766829
42	28736.05	30001.44	104403.48	9.4584271	9.4771421
43	28763.91	30033.15	104412.59	9.4588480	9.4776009
44	28791.77	30064.86	104421.72	9.4592684	9.4780592
45	28819.63	30096.58	104430.86	9.4596884	9.4785172
46	28847.48	30128.31	104440.01	9.4601079	9.4789748
47	28875.33	30160.04	104449.17	9.4605270	9.4794319
48	28903.18	30191.78	104458.33	9.4609456	9.4798887
49	28931.03	30223.52	104467.51	9.4613638	9.4803451
50	28958.87	30255.27	104476.70	9.4617816	9.4808011
51	28986.71	30287.03	104485.90	9.4621989	9.4812566
52	29014.55	30318.79	104495.11	9.4626158	9.4817118
53	29042.39	30350.55	104504.33	9.4630323	9.4821666
54	29070.22	30382.32	104513.57	9.4634483	9.4826210
55	29098.05	30414.10	104522.81	9.4638639	9.4830750
56	29125.88	30445.88	104532.06	9.4642790	9.4835286
57	29153.71	30477.67	104541.32	9.4646938	9.4839818
58	29181.53	30509.46	104550.60	9.4651081	9.4844346
59	29209.35	30541.26	104559.88	9.4655219	9.4848870
60	29237.17	30573.07	104569.18	9.4659353	9.4853390

73 Degrees.

Minutes	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	95881.97	337594.34	352093.65	9.9817370	10.5283952
29	95873.71	337234.08	351748.24	9.9816995	10.5279315
28	95865.43	336874.53	351403.54	9.9816620	10.5274682
27	95857.15	336515.68	351059.54	9.9816245	10.5270053
26	95848.86	336157.53	350716.25	9.9815870	10.5265428
25	95840.56	335800.08	350373.65	9.9815494	10.5260808
24	95832.26	335443.33	350031.75	9.9815117	10.5256192
23	95823.94	335087.28	349690.55	9.9814740	10.5251579
22	95815.62	334731.91	349350.04	9.9814363	10.5246971
21	95807.29	334377.24	349010.23	9.9813986	10.5242367
20	95798.95	334023.26	348671.10	9.9813608	10.5237767
19	95790.60	333669.97	348332.67	9.9813229	10.5233171
18	95782.25	333317.36	347994.92	9.9812850	10.5228579
17	95773.89	332965.43	347657.85	9.9812471	10.5223991
16	95765.52	332614.19	347321.46	9.9812091	10.5219408
15	95757.14	332263.62	346985.76	9.9811711	10.5214828
14	95748.75	331913.73	346650.73	9.9811331	10.5210252
13	95740.35	331564.52	346316.37	9.9810950	10.5205681
12	95731.95	331215.98	345982.69	9.9810569	10.5201113
11	95723.54	330868.11	345649.69	9.9810187	10.5196549
10	95715.12	330520.91	345317.35	9.9809805	10.5191989
9	95706.69	330174.38	344985.68	9.9809423	10.5187434
8	95698.25	329828.51	344654.67	9.9809040	10.5182882
7	95689.81	329483.30	344324.33	9.9808657	10.5178334
6	95681.36	329138.76	343994.65	9.9808273	10.5173790
5	95672.90	328794.87	343665.63	9.9807889	10.5169250
4	95664.43	328451.64	343337.27	9.9807505	10.5164714
3	95655.95	328109.07	343009.56	9.9807120	10.5160182
2	95647.47	327767.15	342682.51	9.9806735	10.5155654
1	95638.98	327425.88	342356.11	9.9806349	10.5151130
0	95630.48	327085.26	342030.36	9.9805963	10.5146610

17 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	29237.17	30573.07	104569.18	9.4659353	9.4853390
1	29264.99	30604.88	104578.48	9.4663483	9.4857907
2	29292.80	30636.69	104587.80	9.4667609	9.4862419
3	29320.61	30668.51	104597.12	9.4671730	9.4866928
4	29348.42	30700.34	104606.46	9.4675848	9.4871433
5	29376.23	30732.18	104615.81	9.4679960	9.4875933
6	29404.03	30764.02	104625.16	9.4684069	9.4880430
7	29431.83	30795.86	104634.53	9.4688173	9.4884924
8	29459.63	30817.71	104643.91	9.4692273	9.4889413
9	29487.43	30859.57	104653.30	9.4696369	9.4893898
10	29515.22	30891.43	104662.70	9.4700461	9.4898380
11	29543.02	30923.30	104672.11	9.4704548	9.4902858
12	29570.80	30955.17	104681.53	9.4708631	9.4907332
13	29598.59	30987.05	104690.96	9.4712710	9.4911802
14	29626.38	31018.93	104700.40	9.4716785	9.4916269
15	29654.16	31050.82	104709.86	9.4720856	9.4920731
16	29681.94	31082.72	104719.32	9.4724922	9.4925190
17	29709.71	31114.62	104728.79	9.4728985	9.4929646
18	29737.49	31149.53	104738.28	9.4733043	9.4934097
19	29765.26	31178.44	104747.77	9.4737097	9.4938545
20	29793.03	31210.36	104757.28	9.4741146	9.4942988
21	29820.79	31242.29	104766.79	9.4745192	9.4947429
22	29848.56	31274.22	104776.32	9.4749234	9.4951865
23	29876.32	31306.16	104785.86	9.4753271	9.4956298
24	29904.08	31338.10	104795.40	9.4757304	9.4960727
25	29931.84	31370.05	104804.96	9.4761334	9.4965152
26	29959.59	31402.00	104814.53	9.4765359	9.4969574
27	29987.34	31433.96	104824.11	9.4769380	9.4973991
28	30015.09	31465.93	104833.70	9.4773396	9.4978406
29	30042.84	31497.90	104843.30	9.4777409	9.4982816
30	30070.58	31529.88	104852.91	9.4781418	9.4987223

72 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	95630.48	327085.26	342030.36	9.9805963	10.5146610
59	95621.97	326745.29	341705.26	9.9805577	10.5142093
58	95613.45	326405.96	341380.80	9.9805190	10.5137581
57	95604.92	326067.28	341056.99	9.9804803	10.5133072
56	95596.39	325729.24	340733.82	9.9804415	10.5128567
55	95587.85	325391.84	340411.30	9.9804027	10.5124067
54	95579.30	325055.08	340089.41	9.9803639	10.5119570
53	95570.74	324718.95	339768.16	9.9803250	10.5115076
52	95562.17	324383.46	339447.54	9.9802860	10.5110587
51	95553.60	324048.60	339127.55	9.9802471	10.5106102
50	95545.02	323714.38	338808.20	9.9802081	10.5101620
49	95536.43	323380.78	338489.48	9.9801690	10.5097142
48	95527.84	323047.80	338171.38	9.9801299	10.5092668
47	95519.23	322715.46	337853.91	9.9800908	10.5088198
46	95510.61	322383.73	337537.07	9.9800516	10.5083731
45	95501.99	322052.63	337220.84	9.9800124	10.5079269
44	95493.36	321722.15	336905.24	9.9799732	10.5074810
43	95484.73	321392.28	336590.26	9.9799339	10.5070354
42	95476.08	321063.04	336275.89	9.9798946	10.5065903
41	95467.42	320734.40	335962.14	9.9798552	10.5061455
40	95458.76	320406.38	335649.00	9.9798158	10.5057012
39	95450.09	320078.97	335336.47	9.9797764	10.5052571
38	95441.41	319752.17	335024.55	9.9797369	10.5048135
37	95432.73	319425.98	334713.24	9.9796973	10.5043700
36	95424.03	319100.39	334402.54	9.9796578	10.5039273
35	95415.33	318775.40	334092.44	9.9796182	10.5034848
34	95406.62	318451.02	333782.94	9.9795785	10.5030426
33	95397.90	318127.24	333474.05	9.9795388	10.5026009
32	95389.17	317804.06	333165.75	9.9794991	10.5021594
31	95380.44	317481.47	332858.05	9.9794593	10.5017184
30	95371.69	317159.48	332550.95	9.9794195	10.5012777

17 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	30070.58	31529.88	104852.91	9.4781418	9.4987223
31	30098.32	31561.86	104862.53	9.4785423	9.4991626
32	30126.06	31593.85	104872.17	9.4789423	9.4996026
33	30153.80	31625.85	104881.81	9.4793420	9.5000422
34	30181.53	31657.85	104891.46	9.4797412	9.5004814
35	30209.26	31689.86	104901.13	9.4801401	9.5009203
36	30236.99	31721.87	104910.80	9.4805385	9.5013588
37	30264.71	31753.89	104920.49	9.4809366	9.5017969
38	30292.44	31785.91	104930.19	9.4813342	9.5022347
39	30320.16	31817.94	104939.89	9.4817315	9.5026721
40	30347.88	31849.98	104949.61	9.4821283	9.5031092
41	30375.59	31882.02	104959.34	9.4825248	9.5035459
42	30403.31	31914.07	104969.08	9.4829208	9.5039822
43	30431.02	31946.13	104978.83	9.4833165	9.5044182
44	30458.72	31978.19	104988.59	9.4837117	9.5048538
45	30486.43	32010.25	104998.36	9.4841066	9.5052891
46	30514.13	32042.32	105008.15	9.4845010	9.5057240
47	30541.83	32074.40	105017.94	9.4848951	9.5061586
48	30569.53	32106.49	105027.74	9.4852888	9.5065928
49	30597.23	32138.58	105037.56	9.4856820	9.5070267
50	30624.92	32170.67	105047.38	9.4860749	9.5074602
51	30652.61	32202.77	105057.22	9.4864674	9.5078933
52	30680.29	32234.88	105067.06	9.4868595	9.5083261
53	30707.98	32267.00	105076.92	9.4872512	9.5087586
54	30735.66	32299.12	105086.79	9.4876426	9.5091907
55	30763.34	32331.25	105096.67	9.4880335	9.5096224
56	30791.02	32363.38	105106.56	9.4884240	9.5100539
57	30818.69	32395.52	105116.46	9.4888143	9.5104849
58	30846.36	32427.66	105126.37	9.4892040	9.5109156
59	30874.03	32459.81	105136.29	9.4895934	9.5113460
60	30901.70	32491.97	105146.22	9.4899824	9.5117760

72 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	95371.69	317159.48	332550.95	9.9794195	10.5012777
29	95362.94	316838.08	332244.44	9.9793796	10.5008374
28	95354.18	316517.28	331938.53	9.9793398	10.5003974
27	95345.42	316197.06	331633.20	9.9792998	10.4999578
26	95336.64	315877.44	331328.47	9.9792599	10.4995186
25	95327.86	315558.40	331024.32	9.9792198	10.4990797
24	95319.07	315239.94	330720.76	9.9791798	10.4986412
23	9531.027	314922.07	330417.78	9.9791397	10.4982031
22	95301.46	314604.78	330115.39	9.9790996	10.4977653
21	95292.64	314288.07	329813.57	9.9790594	10.4973279
20	95283.82	313971.94	329512.34	9.9790192	10.4968908
19	95274.99	313656.39	329211.68	9.9789789	10.4964541
18	95266.15	313341.41	328911.60	9.9789386	10.4960178
17	95257.30	313027.01	328612.09	9.9788983	10.4955818
16	95248.44	312713.17	328313.16	9.9788579	10.4951462
15	95239.58	312399.91	328014.79	9.9788175	10.4947109
14	95230.71	312087.22	327717.00	9.9787770	10.4942760
13	95221.83	311775.09	327419.77	9.9787365	10.4938414
12	95212.94	311463.53	327123.11	9.9786960	10.4934072
11	95204.04	311152.54	326827.02	9.9786554	10.4929733
10	95195.14	310842.10	326531.49	9.9786148	10.4925398
9	95186.23	310532.23	326236.52	9.9785741	10.4921067
8	95177.31	310222.91	325942.11	9.9785334	10.4916739
7	95168.38	309914.16	325648.25	9.9784927	10.4912414
6	95159.44	309605.96	325354.96	9.9784519	10.4908093
5	95150.50	309298.31	325062.22	9.9784111	10.4903776
4	95141.54	308991.22	324770.03	9.9783702	10.4899461
3	95132.58	308684.68	324478.40	9.9783293	10.4895151
2	95123.61	308378.69	324187.32	9.9782883	10.4890844
1	95114.64	308073.25	323896.78	9.9782474	10.4886540
0	95105.65	307768.35	323606.80	9.9782063	10.4882240

18 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	30901.70	32491.97	105146.22	9.4899824	9.5117760
1	30929.36	32524.13	105156.17	9.4903710	9.5122057
2	30957.02	32556.30	105166.12	9.4907592	9.5126351
3	30984.68	32588.48	105176.08	9.4911471	9.5130641
4	31012.34	32620.66	105186.06	9.4915345	9.5134927
5	31039.99	32652.85	105196.05	9.4919216	9.5139210
6	31067.64	32685.04	105206.04	9.4923083	9.5143490
7	31095.29	32717.24	105216.05	9.4926946	9.5147766
8	31122.94	32749.44	105226.07	9.4930806	9.5152039
9	31150.58	32781.65	105236.10	9.4934661	9.5156309
10	31178.22	32813.87	105246.14	9.4938513	9.5160575
11	31205.86	32846.10	105256.19	9.4942361	9.5164838
12	31233.49	32878.33	105266.25	9.4946205	9.5169097
13	31261.12	32910.56	105276.33	9.4950046	9.5173353
14	31288.75	32942.80	105286.41	9.4953883	9.5177606
15	31316.38	32975.05	105296.51	9.4957716	9.5181855
16	31344.00	33007.31	105306.61	9.4961545	9.5186101
17	31371.63	33039.57	105316.73	9.4965370	9.5190344
18	31399.25	33071.84	105326.86	9.4969192	9.5194583
19	31426.86	33104.11	105336.99	9.4973010	9.5198819
20	31454.48	33136.39	105347.14	9.4976824	9.5203052
21	31482.09	33168.68	105357.30	9 4980635	9.5207282
22	31509.69	33200.97	105367.47	9.4984442	9.5211508
23	31537.30	33233.27	105377.65	9.4988245	9.5215730
24	31564.90	33265.57	105387.85	9.4992045	9.5219950
25	31592.50	33297.88	105398.05	9.4995840	9.5224166
26	31620.10	33330.20	105408.26	9.4999633	9.5228379
27	31647.70	33362.52	105418.49	9.5003421	9.5232589
28	31675.29	33394.85	105428.73	9.5007206	9.5236795
29	31702.88	33427.19	105438.97	9.5010987	9.5240999
30	31730.47	33459.53	105449.23	9.5014764	9.5245199

71 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang
90	95105.65	307768.35	323606.80	9.9782063	10.4882240
59	95096.66	307464.00	323317.36	9.9781653	10.4877943
58	95087.66	307160.20	323028.46	9.9781241	10.4873649
57	95078.65	306856.93	322740.11	9.9780830	10.4869359
56	95069.63	306554.21	322452.30	9.9780418	10.4865073
55	95060.60	306252.03	322165.03	9.9780006	10.4860790
54	95051.57	305950.38	321878.30	9.9779593	10.4856510
53	95042.53	305649.28	321592.10	9.9779180	10.4852234
52	95033.48	305348.70	321306.44	9.9778766	10.4847961
51	95024.42	305048.66	321021.32	9.9778353	10.4843691
50	95015.36	304749.15	320736.73	9.9777938	10.4839425
49	95006.29	304450.18	320452.66	9.9777523	10.4835162
48	94997.21	304151.73	320169.13	9.9777108	10.4830903
47	94988.12	303853.81	319886.13	9.9776693	10.4826647
46	94979.02	303556.41	319603.65	9.9776277	10.4822394
45	94969.91	303259.54	319321.70	9.9775860	10.4818145
44	94960.80	302963.20	319040.28	9.9775444	10.4813899
43	94951.68	302667.37	318759.37	9.9775026	10.4809656
42	94942.55	302372.07	318478.99	9.9774609	10.4805417
41	94933.41	302077.28	318199.13	9.9774191	10.4801181
40	94924.26	301783.01	317919.78	9.9773772	10.4796948
39	94915.11	301489.26	317640.95	9.9773354	10.4792718
38	94905.95	301196.02	317362.64	9.9772934	10.4788492
37	94896.78	300903.30	317084.84	9.9772515	10.4784270
36	94887.60	300611.09	316807.56	9.9772095	10.4780050
35	94878.41	300319.39	316530.78	9.9771674	10.4775834
34	94869.22	300028.20	316254.52	9.9771253	10.4771621
33	94860.02	299737.51	315978.76	9.9770832	10.4767411
32	94850.81	299447.34	315703.51	9.9770410	10.4763205
31	94841.59	299157.66	315428.77	9.9769988	10.4759001
30	94832.37	298868.50	315154.53	9.9769566	10.4754801

18 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	31730.47	33459.53	105449.23	9.5014764	9.5245199
31	31758.05	33491.88	105459.50	9.5018538	9.5249395
32	31785.63	33524.24	105469.78	9.5022308	9.5253589
33	31813.21	33556.60	105480.07	9.5026075	9.5257779
34	31840.79	33588.97	105490.37	9.5029838	9.5261966
35	31868.36	33621.34	105500.68	9.5033597	9.5266150
36	31895.93	33653.72	105511.01	9.5037353	9.5270331
37	31923.50	33686.11	105521.34	9.5041105	9.5274508
38	31951.06	33718.50	105531.69	9.5044853	9.5278682
39	31978.63	33750.90	105542.04	9.5048598	9.5282853
40	32006.19	33783.30	105552.41	9.5052339	9.5287021
41	32033.74	33815.71	105562.79	9.5056077	9.5291186
42	32061.30	33848.13	105573.18	9.5059811	9.5295347
43	32088.85	33880.56	105583.58	9.5063542	9.5299505
44	32116.40	33912.99	105593.99	9.5067268	9.5303661
45	32143.95	33945.43	105604.41	9.5070992	9.5307813
46	32171.49	33977.87	105614.85	9.5074712	9.5311961
47	32199.03	34010.39	105625.25	9.5078428	9.5316107
48	32226.57	34042.78	105635.75	9.5082141	9.5320250
49	32254.10	34075.24	105646.21	9.5085850	9.5324389
50	32281.64	34107.71	105656.69	9.5089556	9.5328526
51	32309.17	34140.19	105667.18	9.5093258	9.5332659
52	32336.70	34172.67	105677.68	9.5096956	9.5336789
53	32364.22	34205.16	105688.19	9.5100651	9.5340916
54	32391.74	34237.65	105698.71	9.5104343	9.5345040
55	32419.26	34270.15	105709.24	9.5108031	9.5349161
56	32446.78	34302.66	105719.78	9.5111716	9.5353278
57	32474.29	34335.18	105730.34	9.5115397	9.5357393
58	32501.80	34367.70	105740.90	9.5119074	9.5361505
59	32529.31	34400.23	105751.48	9.5122749	9.5365613
60	32556.82	34432.76	105762.07	9.5126419	9.5369719

71 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	94832.36	298868.50	315154.53	9.9769566	10.4754801
29	94823.13	298579.83	314880.79	9.9769143	10.4750605
28	94813.89	298291.66	314607.56	9.9768720	10.4746411
27	94804.64	298004.00	314334.83	9.9768296	10.4742221
26	94795.38	297716.83	314062.59	9.9767872	10.4738034
25	94786.11	297430.16	313790.86	9.9767447	10.4733850
24	94776.84	297143.99	313519.62	9.9767022	10.4729669
23	94767.56	296858.31	313248.87	9.9766597	10.4725492
22	94758.27	296573.12	312978.62	9.9766171	10.4721318
21	94748.97	296288.42	312708.86	9.9765745	10.4717147
20	94739.66	296004.22	312439.59	9.9765318	10.4712979
19	94730.35	295720.50	312170.81	9.9764891	10.4708814
18	94721.03	295437.27	311902.52	9.9764464	10.4704653
17	94711.70	295154.53	311634.72	9.9764036	10.4700495
16	94702.36	294872.27	311367.40	9.9763608	10.4696339
15	94693.01	294590.50	311100.57	9.9763179	10.4692187
14	94683.66	294309.21	310834.22	9.9762750	10.4688039
13	94674.30	294028.40	310568.35	9.9762321	10.4683893
12	94664.93	293748.07	310302.96	9.9761891	10.4679750
11	94655.55	293468.22	310038.05	9.9761461	10.4675611
10	94646.16	293188.85	309773.63	9.9761030	10.4671474
9	94636.76	292909.95	309509.67	9.9760599	10.4667341
8	94627.36	292631.52	309246.20	9.9760167	10.4663211
7	94617.95	292353.58	308983.19	9.9759736	10.4659084
6	94608.53	292076.10	308720.66	9.9769303	10.4654960
5	94599.10	291799.09	308458.60	9.9758870	10.4650839
4	94589.67	291522.56	308197.02	9.9758437	10.4646722
3	94580.23	291246.49	307935.90	9.9758004	10.4642697
2	94570.78	290970.89	307675.25	9.9757570	10.4638495
1	94561.32	290695.76	307415.07	9.9757135	10.4634387
0	94551.85	290421.09	307155.35	9.9756701	10.4630281

19 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	32556.82	34432.76	105762.07	9.5126419	9.5369719
1	32584.32	34465.30	105772.67	9.5130086	9.5373821
2	32611.82	34497.85	105783.28	9.5133750	9.5377920
3	32639.31	34530.40	105793.90	9.5137410	9.5382017
4	32666.81	34562.96	105804.53	9.5141067	9.5386110
5	32694.30	34595.53	105815.17	9.5144721	9.5390200
6	32721.79	34628.10	105825.83	9.5148371	9.5394287
7	32749.28	34660.68	105836.49	9.5152017	9.5398371
8	32776.76	34693.27	105847.17	9.5155660	9.5402453
9	32804.24	34725.86	105857.86	9.5159300	9.5406531
10	32831.72	34758.46	105868.55	9.5262936	9.5410606
11	32859.19	34791.07	105879.26	9.5266569	9.5414678
12	32886.66	34823.68	105889.99	9.5270198	9.5418747
13	32914.13	34856.30	105900.72	9.5173824	9.5422813
14	32941.60	34888.93	105911.46	9.5177447	9.5426877
15	32969.06	34921.56	105922.21	9.5181066	9.5430937
16	32996.52	34954.20	105932.98	9.5184682	9.5434994
17	33023.98	34986.85	105943.76	9.5188295	9.5439048
18	33051.44	35019.50	105954.54	9.5191904	9.5443100
19	33078.89	35052.16	105965.34	9.5195510	9.5447148
20	33106.34	35084.83	105976.15	9.5199112	9.5451193
21	33133.79	35117.50	105986.97	9.5202711	9.5455236
22	33161.23	35150.18	105997.81	9.5206307	9.5459276
23	33188.67	35182.87	106008.65	9.5209899	9.5063312
24	33216.11	35215.56	106019.51	9.5213488	9.5467346
25	33243.55	35248.26	106030.37	9.5217074	9.5471377
26	33270.98	35280.97	106041.25	9.5220656	9.5475405
27	33298.41	35313.68	106052.14	9.5224235	9.5479430
28	33325.84	35346.40	106063.04	9.5227811	9.5483452
29	33353.27	35379.13	106073.95	9.5231383	9.5487471
30	33380.69	35411.86	106084.87	9.5234953	9.5491487

70 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	94551.86	290421.09	307155.35	9.9756701	10.4630281
59	94542.38	290146.88	306896.10	9.9756265	10.4626179
58	94532.90	289873.14	306637.31	9.9755830	10.4622080
57	94523.41	289599.86	306378.98	9.9755394	10.4617983
56	94513.91	289327.04	306121.11	9.9754957	10.4613890
55	94504.40	289054.67	305863.70	9.9754521	10.4609800
54	94494.89	288782.77	305606.75	9.9754083	10.4605713
53	94485.37	288511.32	305503.26	9.9753646	10.4601629
52	94475.84	288240.33	305094.23	9.9753208	10.4597547
51	94466.30	287969.79	304838.64	9.9752769	10.4593469
50	94456.75	287699.70	304583.52	9.9752330	10.4589394
49	94447.20	287430.07	304328.84	9.9751891	10.4585322
48	94437.64	287160.88	304074.62	9.9751451	10.4581253
47	94428.07	286892.15	303820.84	9.9751011	10.4577187
46	94418.49	286623.86	303567.52	9.9750570	10.4573123
45	94408.90	286356.02	303314.64	9.9750129	10.4569063
44	94399.31	286088.63	303062.21	9.9749688	10.4565006
43	94389.71	285821.68	302810.23	9.9749246	10.4560952
42	94380.10	285555.17	302558.68	9.9748804	10.4556900
41	94370.48	285289.11	302307.59	9.9748361	10.4552852
40	94360.85	285023.49	302056.93	9.9747918	10.4548807
39	94351.22	284758.31	301806.72	9.9747475	10.4544764
38	94341.57	284493.56	301556.94	9.9747031	10.4540724
37	94331.92	284229.22	301307.60	9.9746587	10.4536688
36	94322.27	283965.39	301058.70	9.9746142	10.4532654
35	94312.60	283701.96	300810.24	9.9745697	10.4528623
34	94302.93	283438.96	300562.21	9.9745252	10.4524595
33	94293.25	283176.39	300314.62	9.9744806	10.4520570
32	94283.56	282914.26	300667.46	9.9744359	10.4516548
31	94273.86	282652.56	299820.73	9.9743913	10.4512529
30	94264.15	282391.29	299574.43	9.9743466	10.4508513

19 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	33380.69	35411.86	106084.87	9.5234953	9.5491487
31	33408.10	35444.60	106095.80	9.5238518	9.5495500
32	33435.52	35477.35	106106.75	9.5242081	9.5499511
33	33462.93	35510.10	106117.70	9.5245640	9.5503519
34	33490.34	35542.86	106128.67	9.5249196	9.5507523
35	33517.75	35575.63	106139.65	9.5252749	9.5511525
36	33545.16	35608.40	106150.64	9.5256298	9.5515524
37	33572.56	35641.18	106161.64	9.5259844	9.5519521
38	33599.96	35673.97	106172.65	9.5263387	9.5523514
39	33627.35	35706.76	106183.67	9.5266927	9.5527504
40	33654.75	35739.56	106194.71	9.5270463	9.5531492
41	33682.14	35772.37	106205.75	9.5273997	9.5535477
42	33709.53	35805.18	106216.81	9.5277526	9.5539459
43	33736.91	35838.00	106227.88	9.5281053	9.5543438
44	33764.29	35870.83	106238.96	9.5284577	9.5547415
45	33791.67	35903.67	106250.05	9.5288097	9.5551388
46	33819.05	35936.51	106261.15	9.5291614	9.5555359
47	33846.42	35969.36	106272.27	9.5295128	9.5559327
48	33873.89	36002.22	106283.39	9.5298638	9.5563292
49	33901.16	36035.08	106294.53	9.5302146	9.5567255
50	33928.53	36067.95	106305.68	9.5305650	9.5571214
51	33955.89	36100.83	106316.84	9.5309151	9.5575171
52	33983.25	36133.71	106328.01	9.5312649	9.5579125
53	34010.60	36166.60	106339.19	9.5316143	9.5583077
54	34037.95	36199.50	106350.38	9.5319635	9.5587025
55	34065.30	36232.40	106361.58	9.5323123	9.5590971
56	34092.65	36265.31	106372.80	9.5326608	9.5594914
57	34120.00	36298.23	106384.03	9.5330090	9.5598854
58	34147.34	36331.15	106395.27	9.5333569	9.5602792
59	34174.68	36364.08	106406.52	9.5337044	9.5606727
60	34202.01	36397.02	106417.78	9.5340517	9.5610659

70 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Tang. Log.
30	94264.15	282391.29	299574.43	9.9743466	10.4508513
29	94254.43	282130.45	299328.56	9.9743018	10.4504500
28	94244.71	281870.03	299083.12	9.9742570	10.4500489
27	94234.98	281610.04	298838.11	9.9742122	10.4496481
26	94225.24	281350.48	298593.52	9.9741673	10.4492477
25	94215.50	281091.34	298349.36	9.9741224	10.4488475
24	94205.75	280832.63	298105.63	9.9740774	10.4484476
23	94195.98	280574.33	297862.31	9.9740324	10.4480479
22	94186.21	280316.46	297619.42	9.9739873	10.4476486
21	94176.44	280059.01	297376.95	9.9739422	10.4472496
20	94166.65	279801.98	297134.90	9.9738971	10.4468508
19	94156.86	279545.37	296893.27	9.9738519	10.4464523
18	94147.05	279289.17	296652.05	9.9738067	10.4460541
17	94137.24	279033.39	296411.25	9.9737615	10.4456562
16	94127.43	278778.02	296170.87	9.9737162	10.4452585
15	94117.60	278523.07	295930.90	9.9736709	10.4448612
14	94107.77	278268.53	295691.35	9.9736255	10.4444641
13	94097.93	278014.40	295452.21	9.9735801	10.4440673
12	94088.08	277760.69	295213.48	9.9735346	10.4436708
11	94078.22	277507.38	294975.16	9.9734891	10.4432745
10	94068.35	277254.48	294737.25	9.9734435	10.4428786
9	94058.48	277001.99	294499.75	9.9733980	10.4424829
8	94048.60	276749.90	294262.65	9.9733523	10.4420875
7	94038.71	276498.22	294025.97	9.9733067	10.4416923
6	94028.81	276246.95	293789.68	9.9732610	10.4412975
5	94018.91	275996.08	293553.80	9.9732152	10.4409029
4	94008.99	275745.61	293318.33	9.9731694	10.4405086
3	93999.07	275495.54	293083.26	9.9731236	10.4401146
2	93989.14	275245.88	292848.58	9.9730777	10.4397208
1	93979.21	274996.61	292614.31	9.9730318	10.4393273
0	93969.26	274747.74	292380.44	9.9729858	10.4389341

20 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	34202.01	36397.02	106417.78	9.5340517	9.5610659
1	34229.35	36429.97	106429.05	9.5343986	9.5614588
2	34256.68	36462.92	106440.33	9.5347452	9.5618515
3	34284.00	36495.88	106451.63	9.5350915	9.5622439
4	34311.33	36528.85	106462.94	9.5354375	9.5626360
5	34338.65	36561.82	106474.26	9.5357832	9.5630278
6	34365.97	36594.80	106485.59	9.5361286	9.5634194
7	34393.29	36627.79	106496.93	9.5364737	9.5638107
8	34420.60	36660.79	106508.28	9.5368184	9.5642018
9	34447.92	36693.79	106519.64	9.5371628	9.5645925
10	34475.21	36726.80	106531.01	9.5375070	9.5649831
11	34502.52	36759.82	106542.40	9.5378508	9.5653733
12	34529.82	36792.84	106553.80	9.5381943	9.5657633
13	34557.12	36825.87	106565.21	9.5385375	9.5661530
14	34584.41	36858.91	106576.63	9.5388804	9.5665424
15	34611.71	36891.95	106588.07	9.5392230	9.5669316
16	34639.00	36925.00	106599.51	9.5395653	9.5673205
17	34666.28	36958.06	106610.97	9.5399073	9.5677091
18	34693.57	36991.13	106622.43	9.5402489	9.5680975
19	34720.85	37024.20	106633.91	9.5405903	9.5684856
20	34748.12	37057.28	106645.40	9.5409314	9.5688735
21	34775.40	37090.37	106656.90	9.5412721	9.5692611
22	34802.67	37123.46	106668.42	9.5416126	9.5696484
23	34829.94	37156.56	106679.94	9.5419527	9.5700355
24	34857.20	37189.67	106691.48	9.5422926	9.5704223
25	34884.47	37222.78	106703.02	9.5426321	9.5708088
26	34911.73	37255.90	106714.58	9.5429713	9.5711951
27	34938.98	37289.03	106726.15	9.5433103	9.5715811
28	34966.24	37322.17	106737.74	9.5436489	9.5719669
29	34993.49	37355.32	106749.34	9.5439873	9.5723524
30	35020.74	37388.47	106760.94	9.5443253	9.5727377

69 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	93969.26	274747.74	292380.44	9.9729858	10.4389341
59	93959.31	274499.27	292146.97	9.9729398	10.4385412
58	93949.35	274251.20	291913.89	9.9728938	10.4381485
57	93939.38	274003.52	291681.21	9.9728477	10.4377561
56	93929.40	273756.23	291448.92	9.9728016	10.4373640
55	93919.42	273509.34	291217.03	9.9727554	10.4369722
54	93909.43	273262.84	290985.53	9.9727092	10.4365806
53	93899.42	273016.74	290754.43	9.9726629	10.4361893
52	93889.42	272771.02	290523.72	9.9726166	10.4357982
51	93879.40	272525.69	290293.39	9.9725703	10.4354075
50	93869.37	272280.75	290063.46	9.9725239	10.4350169
49	93859.34	272036.20	289833.91	9.9724775	10.4346267
48	93849.30	271792.04	289604.75	9.9724310	10.4342367
47	93839.25	271548.26	289375.98	9.9723845	10.4338470
46	93829.19	271304.87	289147.60	9.9723380	10.4334576
45	93819.13	271061.86	288919.59	9.9722914	10.4330684
44	93809.06	270819.23	288691.98	9.9722448	10.4326795
43	93798.98	270576.99	288464.74	9.9721981	10.4322909
42	93788.89	270335.13	288237.89	9.9721514	10.4319025
41	93778.80	270093.64	288011.42	9.9721047	10.4315144
40	93768.69	269852.54	287785.32	9.9720579	10.4311265
39	93758.58	269611.81	287559.61	9.9720110	10.4307389
38	93748.46	269371.47	287334.28	9.9719642	10.4303516
37	93738.33	269131.49	287109.32	9.9719172	10.4299645
36	93728.20	268891.90	286884.74	9.9718703	10.4295777
35	93718.06	268652.67	286660.53	9.9718233	10.4291912
34	93707.90	268413.83	286436.70	9.9717762	10.4288049
33	93697.74	268175.35	286213.24	9.9717291	10.4284189
32	93687.58	227937.25	285990.15	9.9716820	10.4280331
31	93677.40	267699.51	285767.44	9.9716348	10.4276476
30	93667.22	267462.15	285545.09	9.9715876	10.4272623

20 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	35020.74	37388.47	106760.94	9.5443253	9.5727377
31	35047.99	37421.63	106772.55	9.5446630	9.5731227
32	35075.23	37454.79	106784.18	9.5450005	9.5735074
33	35102.46	37487.97	106795.82	9.5453376	9.5738919
34	35129.70	37521.15	106807.47	9.5456745	9.5742761
35	35156.93	37554.34	106819.14	9.5460110	9.5746601
36	35184.16	37587.53	106830.81	9.5463472	9.5750438
37	35211.39	37620.73	106842.50	9.5466832	9.5754272
38	35238.62	37653.94	106854.20	9.5470189	9.5758104
39	35265.84	37687.16	106865.91	9.5473542	9.5761934
40	35393.06	37720.38	106877.63	9.5476893	9.5765761
41	35320.27	37753.61	106889.36	9.5480240	9.5769585
42	35347.48	37786.85	106901.10	9.5483585	9.5773407
43	35374.69	37820.10	106912.86	9.5486927	9.5777226
44	35401.90	37853.35	106924.63	9.5490266	9.5781043
45	35429.10	37886.61	106936.41	9.5493602	9.5784858
46	35456.30	37919.88	106948.20	9.5496935	9.5788669
47	35483.50	37953.16	106960.00	9.5500265	9.5792479
48	35510.70	37986.44	106971.82	9.5503592	9.5796286
49	35537.89	38019.73	106983.64	9.5506916	9.5800090
50	35565.08	38053.03	106995.48	9.5510237	9.5803892
51	35592.26	38086.33	107007.33	9.5513556	9.5807691
52	35619.44	38119.64	107019.19	9.5516871	9.5811488
53	35646.62	38152.96	107031.06	9.5520184	9.5815282
54	35673.80	38186.29	107042.95	9.5523494	9.5819074
55	35700.97	38219.62	107054.84	9.5526801	9.5822864
56	35728.14	38252.96	107066.75	9.5530105	9.5826651
57	35755.31	38286.31	107078.67	9.5533406	9.5830435
58	35782.48	38319.67	107090.60	9.5536704	9.5834217
59	35809.64	38353.03	107102.54	9.5539999	9.5837997
60	35836.79	38386.40	107114.50	9.5543292	9.5841774

69 Degrees.

Minutes	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	93667.22	267462.15	285545.09	9.9715876	10.4272623
29	93657.03	267225.16	285323.12	9.9715404	10.4268773
28	93646.83	266988.53	285101.52	9.9714931	10.4264926
27	93636.62	266752.27	284880.28	9.9714457	10.4261081
26	93626.41	266516.38	284659.41	9.9713984	10.4257239
25	93616.18	266280.85	284438.91	9.9713509	10.4253399
24	93605.95	266045.69	284218.77	9.9713035	10.4249562
23	93595.71	265810.89	283998.99	9.9712560	10.4245728
22	93585.47	265576.45	283779.58	9.9712084	10.4241896
21	93575.21	265342.38	283560.54	9.9711608	10.4238066
20	93564.95	265108.67	283341.85	9.9711132	10.4234239
19	93554.68	264875.31	283123.53	9.9710655	10.4230415
18	93544.40	264642.32	282905.56	9.9710178	10.4226593
17	93534.12	264409.69	282687.96	9.9709701	10.4222774
16	93523.82	264177.41	282470.71	9.9709223	10.4218957
15	93513.52	263945.49	282253.82	9.9708744	10.4215242
14	93503.21	263713.92	282037.29	9.9708265	10.4211331
13	93492.89	263482.71	281821.11	9.9707786	10.4207521
12	93482.57	263251.86	281605.29	9.9707306	10.4203714
11	93472.23	263021.36	281389.82	9.9706826	10.4199910
10	93461.89	262791.21	281174.71	9.9706346	10.4196108
9	93451.54	262561.41	280959.95	9.9705865	10.4192309
8	93441.18	262331.96	280745.54	9.9705383	10.4188512
7	93430.82	262102.86	280531.48	9.9704902	10.4184718
6	93420.45	261874.11	280317.77	9.9704419	10.4180926
5	93410.07	261645.71	280104.41	9.9703937	10.4177136
4	93399.68	261417.66	279891.40	9.9703454	10.4173349
3	93389.28	261189.95	279678.73	9.9702970	10.4169565
2	93378.88	260962.59	279466.41	9.9702486	10.4165783
1	93368.46	260735.58	279254.44	9.9702002	10.4162003
0	93358.04	260508.91	279042.81	9.9701517	10.4158226

21 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	35836.79	38386.40	107114.50	9.5543292	9.5841774
1	35863.95	38419.78	107126.47	9.5546581	9.5845549
2	35891.10	38453.17	107138.44	9.5549868	9.5849321
3	35918.25	38486.56	107150.43	9.5553152	9.5853091
4	35945.40	38519.96	107162.44	9.5556433	9.5856859
5	35972.54	38553.37	107174.45	9.5559711	9.5860624
6	35999.68	38586.79	107186.47	9.5562987	9.5864386
7	36026.82	38620.21	107198.51	9.5566259	9.5868147
8	36053.95	38653.64	107210.56	9.5569529	9.5871904
9	36081.08	38687.08	107222.62	9.5572796	9.5875660
10	36108.21	38720.53	107234.69	9.5576060	9.5879413
11	36135.34	38753.98	107246.78	9.5579321	9.5883163
12	36162.46	38787.44	107258.87	9.5582579	9.5886912
13	36189.58	38820.91	107270.98	9.5585835	9.5890657
14	36216.69	38854.39	107283.10	9.5589088	9.5894401
15	36243.80	38887.87	107295.23	9.5592338	9.5898142
16	36270.91	38921.36	107307.37	9.5595585	9.5901881
17	36298.02	38954.86	107319.53	9.5598829	9.5905617
18	36325.12	38988.37	107331.70	9.5602071	9.5909351
19	36352.22	39021.89	107343.88	9.5605310	9.5913082
20	36379.32	39055.41	107356.07	9.5608546	9.5916812
21	36406.41	39088.94	107368.27	9.5611779	9.5920539
22	36433.51	39122.48	107380.48	9.5615010	9.5924263
23	36460.59	39156.02	107392.71	9.5618237	9.5927985
24	36487.68	39189.57	107404.95	9.5621462	9.5931705
25	36514.76	39223.13	107417.20	9.5624685	9.5935422
26	36541.84	39256.70	107429.46	9.5627904	9.5939138
27	36568.91	39290.28	107441.73	9.5631121	9.5942851
28	36595.99	39323.86	107454.02	9.5634335	9.5946561
29	36623.06	39357.45	107466.31	9.5637546	9.5950269
30	36650.12	39391.05	107478.62	9.5640754	9.5953975

68 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
60	93358.04	260508.91	279042.81	9.9701517	10.4158226
59	93347.61	260282.58	278831.53	9.9701032	10.4154451
58	93337.18	260056.59	278620.59	9.9700547	10.4150679
57	93326.73	259830.95	278409.99	9.9700061	10.4146909
56	93316.28	259605.64	278199.73	9.9699574	10.4143141
55	93305.82	259380.68	277989.82	9.9699087	10.4139376
54	93295.35	259156.06	277780.24	9.9698600	10.4135614
53	93284.88	258931.77	277571.00	9.9698112	10.4131853
52	93274.39	258707.82	277362.11	9.9697624	10.4128096
51	93263.90	258484.21	277153.55	9.9697136	10.4124340
50	93253.40	258260.94	276945.32	9.9696647	10.4120587
49	93242.90	258038.00	276737.43	9.9696158	10.4116837
48	93232.38	257815.39	276529.88	9.9695668	10.4113088
47	93221.86	257593.12	276322.66	9.9695177	10.4109333
46	93211.33	257371.18	276115.78	9.9694687	10.4105599
45	93200.79	257149.57	275909.23	9.9694196	10.4101858
44	93190.24	256928.30	275703.01	9.9693704	10.4098119
43	93179.69	256707.35	275497.12	9.9693212	10.4094383
42	93169.12	256486.74	275291.57	9.9692720	10.4090649
41	93158.55	256266.45	275086.34	9.9692227	10.4086918
40	93147.97	256046.49	274881.44	9.9691734	10.4083188
39	93137.39	255826.86	274676.87	9.9691240	10.4079461
38	93126.79	255607.56	274472.63	9.9690746	10.4075737
37	93116.19	255388.58	274268.71	9.9690252	10.4072015
36	93105.58	255169.92	274065.12	9.9689757	10.4068295
35	93094.96	254951.60	273861.86	9.9689262	10.4064577
34	93084.33	254733.59	273658.92	9.9688766	10.4060862
33	93073.70	254515.91	273456.30	9.9688270	10.4057149
32	93063.06	254298.55	273254.00	9.9687773	10.4053439
31	93052.41	254081.51	272052.02	9.9687276	10.4049731
30	93041.76	253864.79	272850.38	9.9686779	10.4046025

21 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	36650.12	39391.05	107478.62	9.5640754	9.5953975
31	36677.19	39424.66	107490.95	9.5643960	9.5957679
32	36704.25	39458.27	107503.28	9.5647163	9.5961380
33	36731.30	39491.89	107515.62	9.5650363	9.5965079
34	36758.36	39525.52	107527.98	9.5653561	9.5968776
35	36785.41	39559.16	107540.35	9.5656756	9.5972470
36	36812.46	39592.80	107552.73	9.5659948	9.5976162
37	36839.50	39626.45	107565.12	9.5663137	9.5979852
38	36866.54	39660.11	107577.53	9.5666314	9.5983540
39	36893.38	39693.78	107589.95	9.5669508	9.5987225
40	36920.61	39727.46	107602.37	9.5672689	9.5990908
41	36947.65	39761.14	107614.81	9.5675868	9.5994588
42	36974.68	39794.83	107627.27	9.5679044	9.5998267
43	37001.70	39828.53	107639.73	9.5682217	9.6001943
44	37028.72	39862.24	107652.21	9.5685387	9.9005617
45	37055.74	39895.96	107664.70	9.5688555	9.6009289
46	37082.76	39929.68	107677.20	9.5691721	9.6012958
47	37109.77	39963.41	107689.71	9.5694883	9.6016625
48	37136.78	39997.15	107702.24	9.5698043	9.6020290
49	37163.79	40030.89	107714.77	9.5701200	9.6023953
50	37190.79	40064.65	107727.32	9.5704355	9.6027613
51	37217.80	40098.41	107739.88	9.5707506	9.6031271
52	37244.79	40132.18	107752.46	9.5710656	9.6034927
53	37271.79	40165.96	107765.04	9.5713802	9.6038581
54	37298.78	40199.75	107777.65	9.5716946	9.6042233
55	37325.77	40233.54	107790.24	9.5720087	9.6045882
56	37352.75	40267.34	107802.87	9.5723226	9.6049529
57	37379.73	40301.15	107815.50	9.5726362	9.6053174
58	37406.71	40334.97	107828.15	9.5729495	9.6056817
59	37433.69	40368.79	107840.80	9.5732626	9.6060457
60	37460.66	40402.62	107853.47	9.5735754	9.6064096

68 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	93041.76	253864.79	272850.38	9.9686779	10.4046025
29	93031.09	253648.39	272649.05	9.9686281	10.4042321
28	93020.42	253432.31	272448.04	9.9685783	10.4038620
27	93009.74	253216.55	272247.35	9.9685284	10.4034921
26	92999.05	253001.11	272046.98	9.9684785	10.4031224
25	92988.35	252785.98	271846.93	9.9684286	10.4027530
24	92977.65	252571.17	271647.19	9.9683786	10.4023838
23	92966.94	252356.67	271447.77	9.9683285	10.4020148
22	92956.22	252142.49	271248.66	9.9682784	10.4016460
21	92945.49	251928.63	271049.87	9.9682283	10.4012775
20	92934.75	251715.07	270851.39	9.9681781	10.4009092
19	92924.01	251501.83	270653.23	9.9681279	10.4005411
18	92913.26	251288.90	270455.38	9.9680777	10.4001733
17	92902.50	251076.29	270257.84	9.9680274	10.3998057
16	92891.73	250863.98	270060.61	9.9679771	10.3994383
15	92880.95	250651.98	269863.70	9.9679267	10.3990711
14	92870.17	250440.29	269667.09	9.9678763	10.3987042
13	92859.38	250228.91	269470.79	9.9678258	10.3983375
12	92848.58	250017.84	269274.80	9.9677753	10.3979710
11	92837.78	249807.07	269079.12	9.9677247	10.3976047
10	92826.96	249596.61	268883.74	9.9676741	10.3972387
9	92816.14	249386.45	268688.67	9.9676235	10.3968729
8	92805.31	249176.60	268493.91	9.9675728	10.3965073
7	92794.47	248967.06	268299.45	9.9675221	10.3961419
6	92783.62	248757.81	268105.30	9.9674713	10.3957767
5	92772.77	248548.87	267911.45	9.9674205	10.3954118
4	92761.91	248340.23	267717.90	9.9673697	10.3950471
3	92751.04	248131.90	267524.65	9.9673188	10.3946826
2	92740.16	247923.86	267331.70	9.9672679	10.3943183
1	92729.28	247716.12	267139.06	9.9672169	10.3939543
0	92718.39	247508.69	266946.72	9.9671659	10.3935904

22 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
0	37460.66	40402.62	107853.47	9.5735754	9.6064096
1	37487.63	40436.46	107866.16	9.5738880	9.6067732
2	37514.59	40470.31	107878.85	9.5742003	9.6071366
3	37541.56	40504.17	107891.56	9.5745123	9.6074997
4	37568.52	40538.04	107904.27	9.5748240	9.6078627
5	37595.47	40571.91	107917.00	9.5751356	9.6082254
6	37622.43	40605.79	107929.75	9.5754468	9.6085880
7	37649.38	40639.68	107942.50	9.5757578	9.6089503
8	37676.32	40673.58	107955.27	9.5760685	9.6093124
9	37703.27	40707.48	107968.05	9.5763790	9.6096742
10	37730.21	40741.39	107980.84	9.5766892	9.6100359
11	37757.14	40775.31	107993.64	9.5769991	9.6103973
12	37784.08	40809.24	108006.46	9.5773088	9.6107586
13	37811.01	40843.18	108019.28	9.5776183	9.6111196
14	37837.94	40877.13	108032.12	9.5779275	9.6114804
15	37864.86	40911.08	108044.97	9.5782364	9.6118409
16	37891.78	40945.04	108057.84	9.5785450	9.6122013
17	37918.70	40979.01	108070.71	9.5788535	9.6125615
18	37945.62	41012.99	108083.60	9.5791616	9.6129214
19	37972.53	41046.97	108096.50	9.5794695	9.6132812
20	37999.44	41080.97	108109.42	9.5797772	9.6136407
21	38026.34	41114.97	108122.34	9.5800845	9.6140000
22	38053.24	41148.98	108135.28	9.5803917	9.6143591
23	38080.14	41183.00	108148.23	9.5806986	9.6147180
24	38107.04	41217.03	108161.19	9.5810052	9.6150766
25	38133.93	41251.06	108174.17	9.5813116	9.6154351
26	38160.82	41285.10	108187.15	9.5816177	9.6157934
27	38187.70	41319.15	108200.15	9.5819236	9.6161514
28	38214.59	41353.21	108213.16	9.5822292	9.6165093
29	38241.47	41387.28	108226.18	9.5825345	9.6168669
30	38268.34	41421.36	108239.22	9.5828397	9.6172243

67 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang
60	92718.39	247508.69	266946.72	9.9671659	10.3935904
59	92707.48	247301.55	266754.67	9.9671148	10.3932268
58	92696.58	247094.70	266562.92	9.9670637	10.3928634
57	92685.66	246888.16	266371.48	9.9670125	10.3925003
56	92674.73	246681.91	266180.33	9.9669614	10.3921373
55	92663.80	246475.96	265989.47	9.9669101	10.3917746
54	92652.86	246270.30	265798.91	9.9668588	10.3914120
53	92641.91	246064.94	265608.65	9.9668075	10.3910497
52	92630.96	245859.87	265418.68	9.9667562	10.3906876
51	92620.00	345655.09	265229.01	9.9667048	10.3903258
50	92609.02	245450.61	265039.62	9.9666533	10.3899641
49	92598.05	245246.42	264850.54	9.9666018	10.3896027
48	92587.06	245042.52	264661.74	9.9665503	10.3892414
47	92576.06	244838.91	264473.23	9.9664987	10.3888804
46	92565.06	244635.59	264285.02	9.9664471	10.3885196
45	92554.05	244432.56	264097.09	9.9663954	10.3881591
44	92543.03	244229.82	263909.46	9.9663437	10.3877987
43	92532.01	244027.36	263722.11	9.9662920	10.3874385
42	92520.97	243825.19	263535.05	9.9662402	10.3870786
41	92509.93	243633.31	263348.28	9.9661884	10.3867188
40	92498.88	243421.72	263161.80	9.9661365	10.3863593
39	92487.82	243220.41	262975.60	9.9660846	10.3860000
38	92476.76	243019.38	262789.69	9.9660326	10.3856409
37	92465.68	242818.64	262604.06	9.9659806	10.3852820
36	92454.60	242618.19	262418.72	9.9659285	10.3849234
35	92443.51	242418.01	262233.66	9.9658764	10.3845649
34	92432.42	242218.12	262048.88	9.9658243	10.3842066
33	92421.31	242018.51	261864.39	9.9657721	10.3838486
32	92410.20	241819.18	261680.18	9.9657199	10.3834907
31	92399.08	241620.13	261496.24	9.9656677	10.3831331
30	92387.95	241421.36	261312.59	9.9656153	10.3827757

22 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	38268.34	41421.36	108239.22	9.5828397	9.6172243
31	38295.22	41455.44	108252.27	9.5831445	9.6175815
32	38322.09	41489.53	108265.33	9.5834491	9.6179385
33	38348.95	41523.63	108278.40	9.5837535	9.6182953
34	38375.82	41557.74	108291.49	9.5840576	9.6186519
35	38402.68	41591.86	108304.58	9.5843615	9.6190083
36	38429.53	41625.99	108317.69	9.5846651	9.6193645
37	38456.39	41660.12	108330.81	9.5849685	9.6197205
38	38483.24	41694.26	108343.95	9.5852716	9.6200762
39	38510.08	41728.41	108357.09	9.5855745	9.6204318
40	38536.93	41762.57	108370.25	9.5858771	9.6207872
41	38563.77	41796.74	108383.42	9.5861795	9.6211423
42	38590.60	41830.91	108396.61	9.5864816	9.6214973
43	38617.44	41865.09	108409.80	9.5867835	9.6218520
44	38644.27	41899.28	108423.01	9.5870851	9.6222066
45	38671.10	41933.48	108436.23	9.5873865	9.6225609
46	38697.92	41967.69	108449.47	9.5876876	9.6229150
47	38724.74	42001.91	108462.71	9.5879885	9.6232690
48	38751.56	42036.13	108475.97	9.5882892	9.6236227
49	38778.37	42070.36	108489.24	9.5885896	9.6239763
50	38805.18	42104.60	108502.52	9.5888897	9.6243296
51	38831.99	42138.85	108515.82	9.5891897	9.6246827
52	38858.80	42173.11	108529.13	9.5894893	9.6250356
53	38885.60	42207.38	108542.45	9.5897888	9.6253884
54	38912.39	42241.66	108555.78	9.5900880	9.6257409
55	38939.19	42275.94	108569.12	9.5903869	9.6260932
56	38965.98	42310.23	108582.48	9.5906856	9.6264454
57	38992.77	42344.53	108595.85	9.5909841	9.6267973
58	39019.55	42378.84	108609.24	9.5912823	9.6271491
59	39046.33	42413.16	108622.63	9.5915803	9.6275006
60	39073.11	42447.49	108636.04	9.5918780	9.6278519

67 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	92387.95	241421.36	261312.59	9.9656153	10.3827757
29	92376.82	241222.86	261129.22	9.9655630	10.3824185
28	92365.67	241024.65	260946.13	9.9655106	10.3820615
27	92354.52	240826.72	260763.32	9.9654582	10.3817047
26	92343.36	240629.06	260580.78	9.9654057	10.3813481
25	92332.20	240431.68	260398.52	9.9653532	10.3809917
24	92321.02	240234.57	260216.54	9.9653006	10.3806355
23	92309.84	240037.74	260034.84	9.9652480	10.3802795
22	92298.65	239841.18	259853.41	9.9651953	10.3799238
21	92287.45	239644.90	259672.25	9.9651426	10.3795682
20	92276.24	239448.89	259491.37	9.9650899	10.3792128
19	92265.03	239253.16	259310.77	9.9650371	10.3788577
18	92253.81	239057.69	259130.43	9.9649843	10.3785027
17	92242.58	238862.50	258950.37	9.9649314	10.3781480
16	92231.34	238667.58	258770.58	9.9648785	10.3777934
15	92220.10	238472.93	258591.07	9.9648256	10.3774391
14	92208.84	238278.55	258411.82	9.9647726	10.3770850
13	92197.58	238084.44	258232.84	9.9647195	10.3767310
12	92186.31	237890.60	258054.14	9.9646665	10.3763773
11	92175.04	237697.03	257875.70	9.9646133	10.3760237
10	92163.75	237503.72	257697.53	9.9645602	10.3756704
9	92152.46	237310.68	257519.63	9.9645069	10.3753173
8	92141.16	237117.91	257341.99	9.9644537	10.3749644
7	92129.86	236925.40	257164.62	9.9644004	10.3746116
6	92118.54	236733.16	256987.52	9.9643470	10.3742591
5	92107.22	236541.18	256810.69	9.9642937	10.3739068
4	92095.89	236349.46	256634.12	9.9642402	10.3735546
3	92084.55	236158.01	256457.81	9.9641868	10.3732027
2	92073.20	235966.83	256281.76	9.9641332	10.3728509
1	92061.85	235775.90	256105.99	9.9640797	10.3724994
0	92050.49	235585.24	255930.47	9.9640261	10.3721481

23 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
0	39073.11	42447.49	108636.04	9.5918780	9.6278519
1	39099.89	42481.82	108649.46	9.5921755	9.6282031
2	39126.66	42516.16	108662.89	9.5924728	9.6285540
3	39153.43	42550.51	108676.34	9.5927698	9.6289048
4	39180.19	42584.87	108689.79	9.5930666	9.6292553
5	39206.95	42619.24	108703.26	9.5933631	9.6296057
6	39233.71	42653.62	108716.75	9.5936594	9.6299558
7	39260.47	42688.00	108730.24	9.5939555	9.6303058
8	39287.22	42722.39	108743.75	9.5942513	9.6306556
9	39313.97	42756.79	108757.27	9.5945469	9.6310052
10	39340.71	42791.20	108770.80	9.5948422	9.6313545
11	39367.45	42825.62	108784.35	9.5951373	9.6317037
12	39394.19	42860.05	108797.91	9.5954322	9.6320527
13	39420.93	42894.49	108811.48	9.5957268	9.6324015
14	39447.66	42928.94	108825.06	9.5960212	9.6327501
15	39474.39	42963.39	108838.66	9.5963154	9.6330985
16	39501.11	42997.85	108852.27	9.5966093	9.6334468
17	39527.83	43032.32	108865.89	9.5969030	9.6337948
18	39554.55	43066.80	108879.52	9.5971965	9.6341426
19	39581.27	43101.29	108893.17	9.5974897	9.6344903
20	39607.98	43135.79	108906.83	9.5977827	9.6348378
21	39634.68	43170.30	108920.50	9.5980754	9.6351850
22	39661.39	43204.81	108934.18	9.5983679	9.6355321
23	39688.09	43239.33	108947.88	9.5986602	9.6358790
24	39714.79	43273.86	108961.59	9.5989523	9.6362257
25	39741.48	43308.40	108975.31	9.5992441	9.6365722
26	39768.17	43342.95	108989.04	9.5995357	9.6369185
27	39794.86	43377.51	109002.79	9.5998271	9.6372646
28	39821.55	43412.08	109016.55	9.6001181	9.6376106
29	39848.23	43446.66	109030.32	9.6004090	9.6379563
30	39874.91	43481.22	109044.11	9.6006997	9.6383019

66 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	92050.49	235585.24	255930.47	9.9640261	10.3721481
59	92039.12	235394.83	255755.21	9.9639724	10.3717969
58	92027.74	235204.69	255580.22	9.9639187	10.3714460
57	92016.35	235014.81	255405.48	9.9638650	10.3710952
56	92004.96	234825.19	255231.01	9.9638112	10.3707447
55	91993.56	234635.82	255056.80	9.9637574	10.3703943
54	91982.15	234446.72	254882.84	9.9637036	10.3700442
53	91970.73	234257.87	254709.15	9.9636496	10.3696942
52	91959.31	234069.28	254535.71	9.9635957	10.3693444
51	91947.88	233880.95	254362.53	9.9635417	10.3689948
50	91936.44	233692.87	254189.61	9.9634877	10.3686455
49	91924.99	233505.05	254016.94	9.9634336	10.3682963
48	91913.53	233317.48	253844.53	9.9633795	10.3679473
47	91902.07	233130.17	253672.38	9.9633253	10.3675985
46	91890.60	232943.11	253500.48	9.9632711	10.3672499
45	91879.12	232756.30	253328.83	9.9632168	10.3669015
44	91867.63	232569.75	253157.44	9.9631625	10.3665532
43	91856.14	232383.45	252986.30	9.9631082	10.3662052
42	91844.64	232197.40	252815.41	9.9630538	10.3658574
41	91833.13	232011.60	252644.78	9.9629994	10.3655097
40	91821.61	231826.06	252474.40	9.9629449	10.3651622
39	91810.09	231640.76	252304.26	9.9628904	10.3648150
38	91798.55	231455.71	252134.38	9.9628358	10.3644679
37	91787.01	231270.91	251964.75	9.9627812	10.3641210
36	91775.46	231086.36	251795.37	9.9627266	10.3637743
35	91763.91	230902.06	251626.24	9.9626719	10.3634278
34	91752.34	230718.01	251457.35	9.9626172	10.3630815
33	91740.77	230534.20	251288.71	9.9625624	10.3627354
32	91729.19	230350.64	251120.32	9.9625076	10.3623894
31	91717.60	230167.32	250952.18	9.9624527	10.3620437
30	91706.01	229984.25	250784.28	9.9623978	10.3616981

23 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	39874.91	43481.24	109044.11	9.6006997	9.6383019
31	39901.58	43515.83	109057.91	9.6009901	9.6386473
32	39928.25	43550.43	109071.72	9.9012803	9.6389925
33	39954.92	43585.04	109085.54	9.6015703	9.6393375
34	39981.58	43619.66	109099.38	9.6018600	9.6396823
35	40008.25	43654.29	109113.23	9.6021495	9.6400269
36	40034.90	43688.93	109127.09	9.6024388	9.6403714
37	40061.56	43723.58	109140.97	9.6027278	9.6407156
38	40088.21	43758.23	109154.86	9.6030166	9.6410597
39	40114.86	43792.89	109168.76	9.6033052	9.6414036
40	40141.50	43827.56	109182.67	9.6035936	9.6417473
41	40168.14	43862.24	109196.59	9.6038817	9.6420908
42	40194.78	43896.93	109210.53	9.6041696	9.6424342
43	40221.41	43931.63	109224.48	9.6044573	9.6427773
44	40248.04	43966.34	109238.45	9.6047448	9.6431203
45	40274.67	44001.06	109252.43	9.6050320	9.6434631
46	40301.29	44035.78	109266.42	9.6053190	9.6438057
47	40327.91	44070.51	109280.42	9.6056057	9.6441481
48	40354.53	44105.25	109294.44	9.6058923	9.6444903
49	40381.14	44140.00	109308.47	9.6061786	9.6448324
50	40407.75	44174.76	109322.51	9.6064647	9.6451743
51	40434.36	44209.53	109336.56	9.6067506	9.6455160
52	40460.96	44244.31	109350.63	9.6070362	9.6458575
53	40487.56	44279.10	109364.71	9.6073216	9.6461988
54	40514.16	44313.90	109378.80	9.6076068	9.6465400
55	40540.75	44348.71	109392.91	9.6078918	9.6468810
56	40567.34	44383.53	109407.03	9.6081765	9.6472217
57	40593.93	44418.35	109421.16	9.6084611	9.6475624
58	40620.51	44453.18	109435.30	9.6087454	9.6479028
59	40647.09	44488.02	109449.46	9.6090294	9.6482431
60	40673.66	44522.87	109463.63	9.6093133	9.6485831

66 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
30	91706.01	229984.25	250784.28	9.9623978	10.3616981
29	91694.40	229801.43	250616.63	9.9623428	10.3613527
28	91682.79	229618.85	250449.23	9.9622878	10.3610075
27	91671.18	229436.51	250282.07	9.9622328	10.3606625
26	91659.55	229254.42	250115.15	9.9621777	10.3603177
25	91647.91	229072.57	249948.47	9.9621226	10.3599731
24	91636.27	228890.96	249782.04	9.9620674	10.3596286
23	91624.62	228709.59	249615.86	9.9620122	10.3592844
22	91612.96	228528.46	249449.91	9.9619569	10.3589403
21	91601.30	228347.58	249284.21	9.9619016	10.3585964
20	91589.63	228166.93	249118.74	9.9618463	10.3582527
19	91577.95	227986.53	248953.52	9.9617909	10.3579092
18	91566.26	227806.36	248788.54	9.9617355	10.3575658
17	91554.56	227626.43	248623.80	9.9616800	10.3572227
16	91542.86	227446.74	248459.29	9.9616245	10.3568797
15	91531.15	227267.29	248295.03	9.9615689	10.3565369
14	91519.43	227088.07	248131.00	9.9615133	10.3561943
13	91507.70	226909.09	247967.21	9.9614576	10.3558519
12	91495.97	226730.35	247803.66	9.9614020	10.3555097
11	91484.22	226551.84	247640.34	9.9613463	10.3551676
10	91472.47	226373.57	247477.26	9.9612904	10.3548257
9	91460.72	226195.53	247314.42	9.9612346	10.3544840
8	91448.95	226017.73	247151.81	9.9611787	10.3541425
7	91437.18	223840.16	247989.43	9.9611228	10.3538012
6	91425.40	225662.83	246827.29	9.9610668	10.3534600
5	91413.61	225485.72	246665.38	9.9610108	10.3531190
4	91401.81	225308.85	246503.71	9.9609548	10.3527783
3	91390.01	225132.21	246342.27	9.9608987	10.3524376
2	91378.19	224955.80	246181.06	9.9608426	10.3520972
1	91366.37	224779.62	246020.08	9.9607864	10.3517569
0	91354.55	224603.68	245859.33	9.9607302	10.3514169

N

24 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	40673.66	44522.87	109463.63	9.6093133	9.6485831
1	40700.23	44557.73	109477.81	9.6095969	9.6489230
2	40726.81	44592.60	109492.01	9.6098803	9.6492628
3	40753.37	44627.48	109506.22	9.6101635	9.6496023
4	40779.93	44662.37	109520.44	9.6104465	9.6499417
5	40806.49	44697.27	109534.67	9.6107293	9.6502809
6	40833.05	44732.17	109548.92	9.6110118	9.6506199
7	40859.60	44767.08	109563.18	9.6112941	9.6509587
8	40886.15	44802.00	109577.46	9.6115762	9.6512974
9	40912.69	44836.93	109591.74	9.6118580	9.6516359
10	40939.23	44871.87	109606.04	9.6121397	9.6519742
11	40965.77	44906.82	109620.36	9.6124211	9.6523123
12	40992.30	44941.78	109634.68	9.6127023	9.6526503
13	41018.83	44976.75	109649.02	9.6129833	9.6529881
14	41045.36	45011.73	109663.37	9.6132641	9.6533257
15	41071.89	45046.72	109677.74	9.6135446	9.6536613
16	41098.41	45081.72	109692.12	9.6138250	9.6540004
17	41124.92	45116.73	109706.51	9.6141051	9.6543375
18	41151.44	45151.74	109720.91	9.6143850	9.6546744
19	41177.95	45186.76	109735.33	9.6146647	9.6550112
20	41204.45	45221.79	109749.76	9.6149441	9.6553477
21	41230.96	45256.83	109764 20	9.6152234	9.6556841
22	41257.45	45291.88	109778.66	9.6155024	9.6560204
23	41283.95	45326.94	109793.13	9.6157812	9.6563564
24	41310.44	45362.01	109807.61	9.6160598	9.6566923
25	41336.93	45397.09	109822.11	9.6163382	9.6570280
26	41363.42	45432.18	109836.62	9.6166164	9.6573636
27	41389.90	45467.28	109851.14	9.6168944	9.6576989
28	41416.38	45502.39	109865.68	9.6171721	9.6580341
29	41442.85	45537.51	109880.23	9.6174496	9.6583692
30	41469.32	45572.64	109894.79	9.6177270	9.6587041

65 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	91354.55	224603.68	245859.33	9.9607302	10.3514169
59	91342.71	224427.96	245698.82	9.9606739	10.3510770
58	91330.87	224252.47	245538.53	9.9606176	10.3507372
57	91319.02	224077.21	245378.48	9.9605612	10.3503977
56	91307.16	223902.18	245218.65	9.9605048	10.3500583
55	91295.29	223727.38	245059.05	9.9604484	10.3497191
54	91283.42	223552.80	244899.68	9.9603919	10.3493801
53	91271.54	223378.45	244740.54	9.9603354	10.3490413
52	91259.65	223204.33	244581.63	9.9602788	10.3487026
51	91247.75	223030.43	244422.94	9.9602222	10.3483641
50	91235.84	222856.76	244264.48	9.9601655	10.3480258
49	91223.93	222683.31	244106.24	9.9601088	10.3476877
48	91212.01	222510.09	243948.23	9.9600520	10.3473497
47	91200.08	222337.09	243790.45	9.9599952	10.3470119
46	91188.14	222164.32	243632.89	9.9599384	10.3466743
45	91176.20	221991.77	243475.55	9.9598815	10.3463369
44	91164.25	221819.44	243318.44	9.9598246	10.3459996
43	91152.29	221647.33	243161.55	9.9597676	10.3456625
42	91140.32	221475.45	243004.89	9.9597106	10.3453256
41	91128.35	221303.79	242848.44	9.9596535	10.3449888
40	91116.37	221132.34	242692.22	9.9595964	10.3446523
39	91104.38	220961.12	242536.22	9.9595393	10.3443159
38	91092.38	220790.12	242380.44	9.9594821	10.3439796
37	91080.38	220619.34	242224.88	9.9594248	10.3436436
36	91068.37	220448.78	242069.54	9.9593675	10.3433077
35	91056.35	220278.43	241914.42	9.9593102	10.3429720
34	91044.32	220108.31	241759.52	9.9592528	10.3426364
33	91032.28	219938.40	241604.84	9.9591954	10.3423011
32	91020.24	219768.71	241450.38	9.9591380	10.3419659
31	91008.19	219599.23	241296.13	9.9590805	10.3416308
30	90996.13	219429.97	241142.10	9.9590229	10.3412960

24 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	41469.32	45572.64	109894.79	9.6177270	9.6587041
31	41495.79	45607.77	109909.36	9.6180041	9.6590387
32	41522.26	45642.91	109923.95	9.6182809	9.6593733
33	41548.72	45678.06	109938.55	9.6185576	9.6597076
34	41575.17	45713.22	109953.17	9.6188341	9.6600418
35	41601.63	45748.39	109967.79	9.6191103	9.6603758
36	41628.08	45783.57	109982.43	9.6193864	9.6607097
37	41654.53	45818.76	109997.09	9.6196622	9.6610434
38	41680.97	45853.96	110011.76	9.6199378	9.6613769
39	41707.41	45889.17	110026.44	9.6202132	9.6617103
40	41733.85	45924.39	110041.13	9.6204884	9.6620434
41	41760.28	45959.62	110055.84	9.6207634	9.6623765
42	41786.71	45994.86	110070.56	9.6210382	9.6627093
43	41813.13	46030.11	110085.29	9.6213127	9.6630420
44	41839.55	46065.37	110100.04	9.6215871	9.6633745
45	41865.97	46100.64	110114.80	9.6218612	9.6637069
46	41892.39	46135.91	110129.57	9.6221351	9.6640391
47	41918.80	46171.19	110144.36	9.6224088	9.6643711
48	41945.21	46206.48	110159.16	9.6226824	9.6647030
49	41971.61	46241.78	110173.97	9.6229557	9.6650346
50	41998.01	46277.09	110188.79	9.6232287	9.6653662
51	42024.41	46312.42	110203.63	9.6235016	9.6656975
52	42050.80	46347.76	110218.49	9.6237743	9.6660288
53	42077.19	46383.11	110233.35	9.6240467	9.6663598
54	42103.58	46418.46	110248.23	9.6243190	9.6666907
55	42129.96	46453.82	110263.13	9.6245911	9.6670214
56	42156.34	46489.19	110278.03	9.6248629	9.6673519
57	42182.72	46524.57	110292.95	9.6251346	9.6676823
58	42209.09	46559.96	110307.89	9.6254060	9.6680126
59	42235.46	46595.36	110322.83	9.6256772	9.6683426
60	42261.83	46630.77	110337.79	9.6259483	9.6686725

65 Degrees.

Minutes	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	90996.13	219429.97	241142.10	9.9590229	10.3412960
29	90984.06	219260.93	240988.29	9.9589653	10.3409613
28	90971.99	219092.10	240834.69	9.9589077	10.3406267
27	90959.90	218923.49	240681.32	9.9588500	10.3402924
26	90947.81	218755.10	240528.15	9.9587923	10.3399582
25	90935.71	218586.91	240375.20	9.9587345	10.3396242
24	90923.61	218418.94	240222.47	9.9586767	10.3392903
23	90911.50	218251.19	240069.95	9.9586188	10.3389566
22	90899.38	218083.64	239917.64	9.9585609	10.3386231
21	90887.25	217916.31	239765.55	9.9585030	10.3382897
20	90875.11	217749.20	239613.67	9.9584450	10.3379566
19	90862.97	217582.29	239462.01	9.9583869	10.3376235
18	90850.82	217415.59	239310.55	9.9583288	10.3372907
17	90838.66	217249.11	239159.31	9.9582707	10.3369580
16	90826.49	217082.83	239008.28	9.9582125	10.3366255
15	90814.32	216916.77	238857.46	9.9581543	10.3362931
14	90802.14	216750.91	238706.85	9.9580961	10.3359609
13	90789.95	216585.27	238556.45	9.9580378	10.3356289
12	90777.75	216419.83	238406.25	9.9579794	10.3352970
11	90765.54	216254.60	238256.27	9.9579210	10.3349654
10	90753.33	216089.58	238106.50	9.9578626	10.3346338
9	90741.11	216924.76	237956.93	9.9578041	10.3343025
8	90728.88	215760.15	237807.58	9.9577456	10.3339712
7	90716.64	215595.75	237658.43	9.9576870	10.3336402
6	90704.40	215431.56	237509.49	9.9576284	10.3333093
5	90692.15	215267.57	237360.75	9.9575697	10.3329786
4	90679.89	215103.78	237212.22	9.9575110	10.3326481
3	90667.62	214940.20	237063.90	9.9574522	10.3323177
2	90655.35	214776.83	236915.78	9.9573934	10.3319874
1	90643.07	214613.66	236767.87	9.9573346	10.3316574
0	90630.78	214450.69	236620.16	9.9572757	10.3313275

25 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
0	42261.83	46630.77	110337.79	9.6259483	9.6686725
1	42288.19	46666.19	110352.77	9.6262191	9.6690023
2	42314.55	46701.62	110367.75	9.6264897	9.6693319
3	42340.90	46737.06	110382.75	9.6267601	9.6696613
4	42367.25	46772.51	110397.77	9.6270303	9.6699906
5	42393.60	46807.97	110412.79	9.6273003	9.6703197
6	42419.94	46843.43	110427.83	9.6275701	9.6706486
7	42446.28	46878.90	110442.89	9.6278397	9.6709774
8	42472.62	46914.38	110457.95	9.6281090	9.6713060
9	42498.95	46949.88	110473.03	9.6283782	9.6716345
10	42525.28	46985.39	110488.13	9.6286472	9.6719628
11	42551.61	47020.90	110503.24	9.6289160	9.6722910
12	42577.93	47056.43	110518.36	9.6291845	9.6726190
13	42604.25	47091.96	110533.49	9.6294529	9.6729468
14	42630.56	47127.51	110548.64	9.6297211	9.6732745
15	42659.87	47163.06	110563.80	9.6299890	9.6736020
16	42683.18	47198.63	110578.98	9.6302568	9.6739294
17	42709.49	47234.20	110594.17	9.6305243	9.6742566
18	42735.79	47269.78	110609.37	9.6307917	9.6745836
19	42762.09	47305.38	110624.58	9.6310589	9.6749105
20	42788.38	47340.98	110639.81	9.6313258	9.6752372
21	42814.67	47376.59	110655.06	9.6315926	9.6755638
22	42840.95	47412.22	110670.31	9.6318591	9.6758902
23	42867.23	47447.85	110685.58	9.6321255	9.6762165
24	42893.51	47483.49	110700.87	9.6323916	9.6765426
25	42919.79	47519.14	110716.16	9.6326576	9.6768686
26	42946.06	47554.81	110731.47	9.6329233	9.6771944
27	42972.33	47590.48	110746.80	9.6331889	9.6775201
28	42998.59	47626.16	110762.14	9.6334542	9.6778456
29	43024.85	47661.85	110777.49	9.6337194	9.6781709
30	43051.11	47697.55	110792.85	9.6339844	9.6784961

64 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	90630.78	214450.69	236620.16	9.9572757	10.3313275
59	90618.48	214287.93	236472.65	9.9572168	10.3309977
58	90606.18	214125.37	236325.35	9.9571578	10.3306681
57	90593.86	213963.01	236178.26	9.9570988	10.3303387
56	90581.54	213800.85	236031.36	9.9570397	10.3300094
55	90569.21	213638.89	235884.67	9.9569806	10.3296803
54	90556.88	213477.14	235738.18	9.9569215	10.3293514
53	90544.54	213315.59	235591.89	9.9568623	10.3290226
52	90532.19	213154.23	235445.81	9.9568030	10.3286940
51	90519.83	212993.08	235299.92	9.9567437	10.3283655
50	90507.46	212832.13	235154.24	9.9566844	10.3280372
49	90495.09	212671.37	235008.75	9.9566250	10.3277090
48	90482.71	212510.82	234863.47	9.9565656	10.3273810
47	90470.32	212350.46	234718.38	9.9565061	10.3270532
46	90457.92	212190.30	234573.49	9.9564466	10.3267255
45	90445.51	212030.34	234428.80	9.9563870	10.3263980
44	90433.10	211870.57	234284.31	9.9563274	10.3260706
43	90420.68	211711.01	234140.02	9.9562678	10.3257434
42	90408.25	211551.64	233995.93	9.9562081	10.3254164
41	90395.82	211392.46	233852.03	9.9561483	10.3250895
40	90383.38	211233.48	233708.33	9.9560886	10.3247628
39	90370.93	211074.70	233564.82	9.9560287	10.3244362
38	90358.47	210916.11	233421.52	9.9559689	10.3241097
37	90346.00	210757.71	233278.40	9.9559089	10.3237835
36	90333.53	210599.51	233135.48	9.9558490	10.3234574
35	90321.05	210441.50	232992.76	9.9557890	10.3231314
34	90308.56	210283.69	232850.23	9.9557289	10.3228056
33	90296.06	210126.07	232707.90	9.9556688	10.3224799
32	90283.56	209968.64	232565.75	9.9556087	10.3221544
31	90271.05	209811.40	232423.81	9.9555485	10.3218291
30	90258.53	209654.36	232282.05	9.9554882	10.3215039

25 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	43051.11	47697.55	110792.85	9.6339844	9.6784961
31	43077.36	47733.26	110808.23	9.6342491	9.6788211
32	43103.61	47768.99	110823.63	9.6345137	9.6791460
33	43129.86	47804.72	110839.03	9.6347780	9.6794708
34	43156.10	47840.46	110854.45	9.6350422	9.6797953
35	43182.34	47876.21	110869.89	9.6353062	9.6801198
36	43208.57	47911.97	110885.33	9.6355699	9.6804440
37	43234.81	47947.74	110900.79	9.6358335	9.6807682
38	43261.03	47983.52	110916.27	9.6360969	9.6810921
39	43287.26	48019.32	110931.76	9.6363601	9.6814160
40	43313.48	48055.12	110947.26	9.6366231	9.6817396
41	43339.70	48090.93	110962.77	9.6368859	9.6820632
42	43365.91	48126.75	110978.30	9.6371484	9.6823865
43	43392.12	48162.58	110993.85	9.6374108	9.6827098
44	43418.32	48198.42	111009.41	9.6376731	9.6830328
45	43444.53	48234.27	111024.98	9.6379351	9.6833557
46	43470.72	48270.14	111040.56	9.6381969	9.6836785
47	43496.92	48306.01	111056.16	9.6384585	9.6840011
48	43523.11	48341.89	111071.77	9.6387199	9.6843236
49	43549.30	48377.78	111087.40	9.6389812	9.6846459
50	43575.48	48413.68	111103.04	9.6392422	9.6849681
51	43601.66	48449.59	111118.69	9.6395030	9.6852901
52	43627.84	48485.52	111134.36	9.6397637	9.6856120
53	43654.01	48521.45	111150.04	9.6400241	9.6859338
54	43680.18	48557.39	111165.73	9.6402844	9.6862553
55	43706.34	48593.34	111181.44	9.6405445	9.6865768
56	43732.51	48629.31	111197.16	9.6408044	9.6868981
57	43758.66	48665.28	111212.90	9.6410640	9.6872192
58	43784.82	48701.26	111228.65	9.6413235	9.6875402
59	43810.97	48737.26	111244.42	9.6415828	9.6878611
60	43837.11	48773.26	111260.19	0.6418420	9.6881818

64 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
30	90258.53	209654.36	232282.05	9.9554882	10.3215039
29	90246 00	209497.51	232140.49	9.9554280	10.3211789
28	90233.47	209340.84	231999.11	9.9553676	10.3208540
27	90220.92	209184.37	231857.94	9.9553073	10.3205292
26	90208.38	209028.09	231716.95	9.9552469	10.3202047
25	90195.82	208872.00	231576.15	9.9551864	10.3198803
24	90183.25	208716.10	231435.54	9.9551259	10.3195560
23	90170.68	208560.39	231295.13	9.9550653	10.3192318
22	90158.10	208404.86	231154.90	9.9550047	10.3189079
21	90145.51	208249.53	231014.86	9.9549441	10.3185840
20	90132.92	208094.38	230875.01	9.9548834	10.3182604
19	90120.31	207939.42	230735.35	9.9548227	10.3179368
18	90107.70	207784.65	230595.88	9.9547619	10.3176135
17	90095.08	207630.07	230456.60	9.9547011	10.3172902
16	90082.45	207475.67	230317.51	9.9546402	10.3169672
15	90069.82	207321.46	230178.60	9.9545793	10.3166443
14	90057.18	207167.43	230039.88	9.9545184	10.3163215
13	90044.53	207013.59	229901.34	9.9544574	10.3159989
12	90031.82	206859.93	229762.99	9.9543963	10.3156764
11	90019.21	206706.46	229624.83	9.9543352	10.3153541
10	90006.54	206553.18	229486.85	9.9542741	10.3150319
9	89993.86	206400.09	229349.06	9.9542129	10.3147099
8	89981.17	206247.16	229211.45	9.9541517	10.3143880
7	89968.48	206094.42	229074.03	9.9540904	10.3140662
6	89955.78	205941.87	228936.79	9.9540291	10.3137447
5	89943.07	205789.50	228799.74	9.9539677	10.3134232
4	89930.35	205637.32	228662.86	9.9539063	10.3131019
3	89917.63	205485.31	228526.18	9.9538448	10.3127808
2	89904.89	205333.49	228389.67	9.9537833	10.3124598
1	89892.15	205181.84	228253.34	9.9537218	10.3121389
0	89879.40	205030.38	228117.20	9.9536602	10.3118182

26 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
0	43837.11	48773.26	111260.19	9.6418420	9.6881818
1	43863.26	48809.27	111275.98	9.6421009	9.6885023
2	43889.40	48845.30	111291.79	9.6423596	9.6888227
3	43915.53	48881.33	111307.61	9.6426182	9.6891430
4	43941.66	48917.37	111323.45	9.6428765	9.6894631
5	43967.79	48953.43	111339.30	9.6431347	9.6897831
6	43993.92	48989.49	111355.16	9.6433926	9.6901030
7	44020.04	49025.57	111371.03	9.6436504	9.6904226
8	44046.15	49061.66	111386.92	9.6439080	9.6907422
9	44072.27	49097.75	111402.82	9 6441654	9.6910616
10	44098.38	49133.86	111418.74	9.6444226	9.6913809
11	44124.48	49169.97	111434.67	9.6446796	9.6917000
12	44150.58	49206.10	111450.62	9.6449365	9.6920189
13	44176.68	49242.24	111466.58	9.6451931	9.6923378
14	44202.78	49278.38	111482.55	9.6454496	9.6926565
15	44228.87	49314.54	111498.54	9.6457058	9.6929750
16	44254.96	49350.71	111514.54	9.6459619	9.6932934
17	44281.04	49386.89	111530.56	9.6462178	9.6936117
18	44307.12	49423.08	111546.59	9.6464735	9.6939298
19	44333.19	49459.28	111562.63	9.6467290	9.6942478
20	44359.27	49495.49	111578.69	9.6469844	9.6945656
21	44385.34	49531.71	111594.76	9.6472395	9.6948833
22	44411.40	49567.94	111610.84	9.6474945	9.6952009
23	44437.46	49604.18	111626.94	9.6477492	9.6955183
24	44463.52	49640.43	111643.06	9.6480038	9.6958355
25	44489.57	49676.69	111659.19	9.6482582	9.6961527
26	44515.62	49712.97	111675.33	9.6485124	9.6964697
27	44541.67	49749.25	111691.49	9.6487665	9.6967865
28	44567.71	49785.54	111707.66	9.6490203	9.6971032
29	44593.75	49821.85	111723.84	9.6492740	9.6974198
30	44619.78	49858.16	111740.04	9.6495274	9.6977363

63 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang
60	89879.40	205030.38	228117.20	9.9536602	10.3118182
59	89866.65	204879.10	227981.24	9.9535985	10.3114977
58	89853.89	204728.00	227845.46	9.9535369	10.3111773
57	89841.12	204577.08	227709.86	9.9534751	10.3108570
56	89828.34	204426.34	227574.45	9.9534134	10.3105369
55	89815.55	204275.78	227439.21	9.9533515	10.3102169
54	89802.76	204125.40	227304.15	9.9532897	10.3098970
53	89789.96	203975.19	227169.27	9.9532278	10.3095774
52	89777.15	203825.17	227034.57	9.9531658	10.3092578
51	89764.33	203675.32	226900.05	9.9531038	10.3089384
50	89751.51	203525.65	226765.71	9.9530418	10.3086191
49	89738.68	203376.15	226631.55	9.9529797	10.3083000
48	89725.84	203226.83	226497.56	9.9529175	10.3079811
47	89712.99	203077.69	226363.75	9.9528553	10.3076622
46	89700.14	202928.73	226230.12	9.9527931	10.3073435
45	89687.27	202779.94	226096.67	9.9527308	10.3070250
44	89674.40	202631.33	225963.39	9.9526685	10.3067066
43	89661.52	202482.89	225830.29	9.9526061	10.3063883
42	89648.64	202334.62	225697.36	9.9525437	10.3060702
41	89635.75	202186.53	225564.61	9.9524813	10.3057522
40	89622.85	202038.62	225432.04	9.9524188	10.3054344
39	89609.94	201890.88	225299.64	9.9523562	10.3051167
38	89597.03	201743.31	225167.41	9.9522936	10.3047991
37	89584.11	201595.92	225035.36	9.9522310	10.3044817
36	89571.18	201448.69	224903.48	9.9521683	10.3041645
35	89558.24	201301.64	224771.78	9.9521055	10.3038473
34	89545.29	201154.77	224640.24	9.9520428	10.3035303
33	89532.34	201008.06	224508.89	9.9519799	10.3032135
32	89519.38	200861.53	224377.70	9.9519171	10.3028968
31	89506.41	200715.16	224246.69	9.9518541	10.3025802
30	89493.44	200568.97	224115.84	9.9517912	10.3022637

26 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	44619.78	49858.16	111740.04	9.6495274	9.6977363
31	44645.81	49894.49	111756.25	9.6497807	9.6980526
32	44671.84	49930.82	111772.48	9.6500338	9.6983687
33	44697.86	49967.17	111788.72	9.6502868	9.6986847
34	44723.88	50003.52	111804.98	9.6505395	9.6990006
35	44749.90	50039.89	111821.25	9.6507920	9.6993164
36	44775.91	50076.27	111837.53	9.6510444	9.6996320
37	44801.92	50112.66	111853.83	9.6512966	9.6999474
38	44827.92	50149.06	111870.14	9.6515486	9.7002628
39	44853.92	50185.47	111886.47	9.6518004	9.7005780
40	44879.92	50221.89	111902.81	9.6520521	9.7008930
41	44905.91	90258.32	111919.16	9.6523035	9.7012080
42	44931.90	50294.76	111935.53	9.6525548	9.7015227
43	44957.89	50331.21	111951.91	9.6528059	9.7018374
44	44983.87	50367.67	111968.31	9.6530568	9.7021519
45	45009.85	50404.15	111984.72	9.6533075	9.7024663
46	45035.82	50440.63	112001.15	9.6535581	9.7027805
47	45061.79	50477.13	112017.59	9.6538084	9.7030946
48	45087.76	50513.63	112034.05	9.6540586	9.7034086
49	45113.72	50550.15	112050.52	9.6543086	9.7037225
50	45139.68	50586.68	112067.00	9.6545584	9.7040362
51	45165.63	50623.22	112083.50	9.6548081	9.7043497
52	45191.58	50659.77	112100.01	9.6550575	9.7046632
53	45217.53	50696.33	112116.53	9.6553068	9.7049765
54	45243.47	50732.90	112133.07	9.6555559	9.7052897
55	45269.41	50769.48	112149.63	9.6558048	9.7056027
56	45295.35	50806.07	112166.20	9.6560536	9.7059156
57	45321.28	50842.67	112182.78	9.6563021	9.7062284
58	45347.21	50879.28	112199.38	9.6565505	9.7065410
59	45373.13	50915.91	112216.00	9.6567987	9.7068535
60	45399.05	50952.54	112232.62	9.6570468	9.7971659

63 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	89593.44	200568.97	224115.84	9.9517912	10.3022637
29	89480.45	200422.95	223985.17	9.9517282	10.3019474
28	89467.46	200277.10	223854.67	9.9516651	10.3016313
27	89454.46	200131.42	223724.35	9.9516020	10.3013153
26	89441.46	199985.90	223594.19	9.9515389	10.3009994
25	89428.44	199840.56	223464.20	9.9514757	10.3006836
24	89415.42	199695.39	223334.38	9.9514124	10.3003680
23	89402.39	199550.38	223204.74	9.9513492	10.3000526
22	89389.36	199405.54	223075.26	9.9512858	10.2997372
21	89376.32	199260.87	222945.95	9.9512224	10.2904220
20	89363.26	199116.37	222816.81	9.9511590	10.2991070
19	89350.21	198972.04	222687.83	9.9510956	10.2987920
18	89337.14	198827.87	222559.03	9.9510320	10.2984773
17	89324.06	198683.87	222430.39	9.9509685	10.2981626
16	89310.98	198540.03	222301.92	9.9509049	10.2978481
15	89297.89	198396.36	222173.62	9.9508412	10.2975337
14	89284.80	198252.86	222045.48	9.9507775	10.2972195
13	89271.69	198109.52	221917.51	9.9507138	10.2969054
12	89258.58	197966.35	221789.71	9 9506500	10.2965914
11	89245.46	197823.34	221662.07	9.9505861	10.2962775
10	89232.34	197680.50	221534.60	9.9505223	10.2959638
9	89219.20	197537.82	221407.30	9.9504583	10.2956503
8	89206.06	197395.31	221280.16	9.9503944	10.2953368
7	89192.91	197252.96	221153.18	9.9503303	10.2950235
6	89179.75	197110.77	221026.37	9.9502663	10.2947103
5	89166.59	196968.74	220899.72	9.9502022	10.2943973
4	89153.42	196826.88	220773.23	9.9501380	10.2940844
3	89140.24	196685.18	220646.91	9.9500738	10.2937716
2	89127.05	196543.64	220520.75	9.9500095	10.2934590
1	89113.85	196402.27	220394.76	9.9499452	10.2931465
0	89100.65	196261.05	220268.93	9.9498809	10.2928341

27 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
0	45399.05	50952.54	112232.62	9.6570468	9.7071659
1	45424.97	50989.19	112249.26	9.6572946	9.7074781
2	45450.88	51025.85	112265.92	9.6575423	9.7077092
3	45476.79	51062.52	112282.59	9.6577898	9.7081022
4	45502.69	51099.19	112299.28	9.6580371	9.7084141
5	45528.59	51135.88	112315.98	9.6582842	9.7087258
6	45554.49	51172.59	112332.69	9.6585312	9.7090374
7	45580.38	51209.30	112349.42	9.6587780	9.7093488
8	45606.27	51246.02	112366.16	9.6590246	9.7096601
9	45632.16	51282.75	112382.92	9.6592710	9.7099713
10	45658.04	51319.50	112399.69	9.6595173	9.7102824
11	45683.92	51356.25	112416.48	9.6597634	9.7105933
12	45709.79	51393.02	112433.28	9.6600093	9.7109041
13	45735.66	51429.80	112450.10	9.6602550	9.7112148
14	45761.53	51466.58	112466.93	9.6605005	9.7115254
15	45787.39	51503.38	112483.77	9.6607459	9.7118358
16	45813.25	51540.19	112500.63	9.6609911	9.7121461
17	45839.10	51577.02	112517.50	9.6612361	9.7124562
18	45864.96	51613.85	112534.39	9.6614810	9.7127662
19	45890.80	51650.69	112551.29	9.6617257	9.7130761
20	45916.65	51687.55	112568.21	9.6619701	9.7133859
21	45942.48	51724.41	112585.14	9.6622145	9.7136956
22	45968.32	51761.29	112602.09	9.6624586	9.7140051
23	45994.15	51798.18	112619.05	9.6627026	9.7143145
24	46019.98	51835.08	112636.03	9.6629464	9.7146237
25	46045.80	51871.99	112653.02	9.6631900	9.7149329
26	46071.62	51908.91	112670.03	9.6634335	9.7152419
27	46097.44	51945.84	112687.05	9.6636768	9.7155508
28	46123.25	51982.78	112704.08	9.6639199	9.7158595
29	46149.06	52019.74	112721.13	9.6641628	9.7161682
30	46174.86	52056.70	112738.19	9.6644056	9.7164767

62 Degrees.

Minutes.	Sines.	Tangents	Secants.	Log. Sin.	Log. Tang.
60	89100.65	196261.05	220268.93	9.9498809	10.2928341
59	89087.44	196120.00	220143.26	9.9498165	10.2925219
58	89074.22	195979.10	220017.75	9.9497521	10.2922098
57	89061.00	195838.37	219892.40	9.9496876	10.2918978
56	89047.77	195697.80	219767.21	9.9496230	10.2915859
55	89034.53	195557.39	219642.19	9.9495585	10.2912742
54	89021.28	195417.13	219517.33	9.9494938	10.2909626
53	89008.02	195277.04	219392.62	9.9494292	10.2906512
52	88994.76	195137.11	219268.08	9.9493645	10.2903399
51	88981.49	194997.33	219143.70	9.9492997	10.2900287
50	88968.21	194857.71	219019.47	9.9492349	10.2897176
49	88954.93	194718.26	218895.41	9.9491700	10.2894067
48	88941.64	194578.96	218771.50	9.9491051	10.2890959
47	88928.34	194439.81	218647.75	9.9490402	10.2887852
46	88915.03	194300.83	218524.17	9.9489752	10.2884746
45	88901.71	194162.00	218400.74	9.9489101	10.2881642
44	88888.39	194023.33	218277.46	9.9488450	10.2878539
43	88875.06	193884.81	218154.35	9.9487799	10.2875438
42	88861.72	193746.45	218031.39	9.9487147	10.2872338
41	88848.37	193608.25	217908.59	9.9486495	10.2869239
40	88835.02	193470.20	217785.94	9.9485842	10.2866141
39	88821.66	193332.31	217663.46	9.9485189	10.2863044
38	88808.30	193194.57	217541.12	9.9484535	10.2859949
37	88794.92	193056.98	217418.95	9.9483881	10.2856855
36	88781.54	192919.56	217296.93	9.9483227	10.2853763
35	88768.15	192782.28	217175.06	9.9482572	10.2850671
34	88754.75	192645.16	217053.35	9.9481916	10.2847581
33	88741.34	192508.19	216931.80	9.9481260	10.2844492
32	88727.93	192371.38	216810.40	9.9480604	10.2841405
31	88714.51	192234.72	216689.15	9.9479947	10.2838318
30	88701.08	192098.21	216568.06	9.9479289	10.2835233

27 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	46174.86	52056.70	112738.19	9.6644056	9.7164767
31	46200.66	52093.68	112755.27	9.6646482	9.7167851
32	46226.46	52130.67	112772.37	9.6648906	9.7170933
33	46252.25	52167.67	112789.48	9.6651329	9.7174014
34	46278.04	52204.68	112806.60	9.6653749	9.7177094
35	46303.82	52241.70	112823.74	9.6656168	9.7180173
36	46329.60	52278.74	112840.89	9.6658586	9.7183251
37	46355.38	52315.78	112858.06	9.6661001	9.7186327
38	46381.15	52352.84	112875.24	9.6663415	9.7189402
39	46406.92	52389.90	112892.44	9.6665828	9.7192476
40	46432.69	52426.98	112909.65	9.6668238	9.7195549
41	46458.45	52464.07	112926.88	9.6670647	9.7198620
42	46484.20	52501.17	112944.12	9.6673054	9.7201690
43	46509.96	52538.29	112961.37	9.6675459	9.7204759
44	46535.71	52575.41	112978.64	9.6677863	9.7207827
45	46561.45	52612.54	112995.93	9.6680265	9.7210893
46	46587.19	52649.69	113013.23	9.6682665	9.7213958
47	46612.93	52686.85	113030.55	9.6685064	9.7217022
48	46638.66	52724.02	113047.88	9.6687461	9.7220085
49	46664.39	52761.20	113065.22	9.6689856	9.7223147
50	46690.12	52798.39	113082.58	9.6692250	9.7226207
51	46715.84	52835.59	113099.96	9.6694642	9.7229266
52	46741.56	52872.81	113117.35	9.6697032	9.7232324
53	46767.27	52910.04	113134.75	9.6699420	9.7235381
54	46792.98	52947.27	113152.17	9.6701807	9.7238436
55	46818.69	52984.52	113169.61	9.6704192	9.7241490
56	46844.39	53021.78	113187.06	9.6706576	9.7244543
57	46870.09	53059.06	113204.52	9.6708958	9.7247595
58	46895.78	53096.34	113222.00	9.6711338	9.7250646
59	46921.47	53133.64	113239.50	9.6713716	9.7253695
60	46947.16	53170.94	113257.01	9.6716093	9.7256744

62 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
30	88701.08	192098.21	216568.06	9.9479289	10.2835233
29	88687.64	191961.86	216447.12	9.9478631	10.2832149
28	88674.20	191825.65	216326.33	9.9477973	10.2829067
27	88660.75	191689.60	216205.70	9.9477314	10.2825986
26	88647.30	191553.70	216085.22	9.9476655	10.2822906
25	88633.83	191417.95	215964.89	9.9475995	10.2819827
24	88620.36	191282.36	215844.71	9.9475335	10.2816749
23	88606.88	191146.91	215724.69	9.9474674	10.2813673
22	88593.39	191011.62	215604.82	9.9474013	10.2810598
21	88579.89	190876.47	215485.10	9.9473352	10.2807524
20	88566.39	190741.47	215365.53	9.9472689	10.2804451
19	88552.88	190606.63	215246.11	9.9472027	10.2801380
18	88539.36	190471.93	215126.84	9.9471364	10.2798310
17	88525.83	190337.38	215007.72	9.9470700	10.2795241
16	88512.30	190202.99	214888.75	9.9470036	10.2792173
15	88498.76	190068.74	214769.93	9.9469372	10.2789107
14	88485.22	189934.64	214651.27	9.9468707	10.2786042
13	88471.66	189800.68	214532.75	9.9468042	10.2782978
12	88458.10	189666.88	214414.37	9.9467376	10.2779915
11	88444.53	189533.22	214296.15	9.9466710	10.2776853
10	88430.95	189399.71	214178.08	9.9466043	10.2773793
9	88417.36	189266.34	214060.15	9.9465376	10.2770734
8	88403.77	189133.13	213942.38	9.9464708	10.2767676
7	88390.17	189000.06	213824.75	9.9464040	10.2764619
6	88376.56	188867.13	213707.26	9.9463371	10.2761564
5	88362.95	188734.36	213589.93	9.9462702	10.2758510
4	88349.32	188601.72	213472.74	9.9462032	10.2755457
3	88335.69	188469.24	213355.70	9.9461362	10.2752405
2	88322.06	188336.90	213238.80	9.9460692	10.2749354
1	88308.41	188204.70	213122.05	9.9460021	10.2746305
0	88294.76	188072.65	213005.45	9.9459349	10.2743256

28 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	46947.16	53170.94	113257.01	9.6716093	9.7256744
1	46972.84	53208.26	113274.53	9.6718468	9.7259791
2	46998.52	53245.59	113292.07	9.6720841	9.7262837
3	47024.19	53282.93	113309.62	9.6723213	9.7265881
4	47049.86	53320.29	113327.19	9.6725583	9.7268925
5	47075.53	53357.65	113344.78	9.6727952	9.7271967
6	47101.19	53395.03	113362.38	9.6730319	9.7275008
7	47126.85	53432.42	113379.99	9.6732684	9.7278048
8	47152.50	53469.82	113397.62	9.6735047	9.7281087
9	47172.15	53507.23	113415.27	9.6737409	9.7284124
10	47203.80	53544.65	113432.93	9.6739769	9.7287161
11	47229.44	53582.08	113450.60	9.6742128	9.7290196
12	47255.08	53619.53	113468.29	9.6744485	9.7293230
13	47280.71	53656.99	113486.00	9.6746840	9.7296263
14	47306.34	53694.46	113503.72	9.6749194	9.7299295
15	47331.97	53731.94	113521.46	9.6751546	9.7302325
16	47357.59	53769.43	113539.21	9.6753896	9.7305354
17	47383.21	53806.94	113556.98	9.6756245	9.7308383
18	47408.82	53844.45	113574.76	9.6758592	9.7311410
19	47434.43	53881.98	113592.55	9.6760937	9.7314436
20	47460.04	53919.52	113610.36	9.6763281	9.7317460
21	47485.64	53957.07	113628.19	9.6765623	9.7320484
22	47511.24	53994.64	113646.03	9.6767963	9.7323506
23	47536.83	54032.21	113663.89	9.6770302	9.7326527
24	47562.42	54069.80	113681.76	9.6772640	9.7329547
25	47588.01	54107.40	113699.65	9.6774975	9.7332566
26	47613.59	54145.01	113717.55	9.6777309	9.7335584
27	47639.17	54182.63	113735.47	9.6779642	9.7338601
28	47664.74	54220.27	113753.40	9.6781972	9.7341616
29	47690.31	54257.91	113771.35	9.6784301	9.7344631
30	47715.88	54295.57	113789.32	9.6786629	9.7347644

61 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	88294.76	188072.65	213005.45	9.9459349	10.2743256
59	88281.10	187940.74	212888.99	9.9458677	10.2740209
58	88267.43	187808.98	212772.67	9.9458005	10.2737163
57	88253.76	187677.36	212656.51	9.9457332	10.2734119
56	88240.07	187545.88	212540.48	9.9456659	10.2731075
55	88226.38	187414.55	212424.60	9.9455985	10.2728033
54	88212.69	187283.36	212308.87	9.9455310	10.2724992
53	88198.98	187152.31	212193.28	9.9454636	10.2721952
52	88185.27	187021.41	212077.83	9.9453960	10.2718913
51	88171.55	186890.64	211962.53	9.9453285	10.2715876
50	88157.82	186760.03	211847.37	9.9452609	10.2712839
49	88144.09	186629.55	211732.35	9.9451932	10.2709804
48	88130.35	186499.21	211617.48	9.9451255	10.2706770
47	88116.60	186369.02	211502.74	9.9450577	10.2703737
46	88102.84	186238.96	211388.15	9.9449899	10.2700705
45	88089.07	186109.05	211273.71	9.9449220	10.2697675
44	88075.30	185979.28	211159.40	9.9448541	10.2694646
43	88061.52	185849.65	211045.23	9.9447862	10.2691617
42	88047.73	185720.15	210931.21	9.9447182	10.2688590
41	88033.94	185590.80	210817.33	9.9446501	10.2685564
40	88020.14	185461.59	210703.59	9.9445821	10.2682540
39	88006.33	185332.52	210589.98	9.9445139	10.2679516
38	87992.51	185203.58	210476.52	9.9444457	10.2676494
37	87978.69	185074.79	210363.20	9.9443775	10.2673473
36	87964.86	184946.13	210250.02	9.9443092	10.2670453
35	87951.02	184817.61	210136.98	9.9442409	10.2667434
34	87937.17	184689.23	210024.08	9.9441725	10.2664416
33	87923.32	184560.99	209911.31	9.9441041	10.2661399
32	87909.46	184432.89	209798.69	9.9440356	10.2658384
31	87895.59	184304.92	209686.20	9.9439671	10.2655369
30	87881.71	184177.09	209573.85	9.9438985	10.2652356

28 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	47715.88	54295.57	113789.32	9.6786629	9.7347644
31	47741.44	54333.24	113807.30	9.6788955	9.7350656
32	47767.60	54370.92	113825.29	9.6791279	9.7353667
33	47792.55	54408.62	113843.30	9.6793602	9.7356677
34	47818.10	54446.32	113861.33	9.6795923	9.7359685
35	47843.64	54484.04	113879.37	9.6798243	9.7362693
36	47869.19	54521.77	113897.43	9.6800560	9.7365699
37	47894.72	54559.51	113915.50	9.6802877	9.7368705
38	47920.26	54597.26	113933.59	9.6805191	9.7371709
39	47945.79	54635.03	113951.69	9.6807504	9.7374712
40	47971.31	54672.81	113969.81	9.6809816	9.7377714
41	47996.83	54710.60	113987.94	9.6812126	9.7380715
42	48022.35	54748.40	114006.09	9.6814434	9.7383714
43	48047.86	54786.21	114024.25	9.6816741	9.7386713
44	48073.37	54824.04	114042.43	9.6819046	9.7389710
45	48098.88	54861.88	114060.62	9.6821349	9.7392707
46	48124.38	54899.73	114078.83	9.6823651	9.7395702
47	48149.87	54937.59	114097.06	9.6825952	9.7398696
48	48175.37	54975.46	114115.30	9.6828250	9.7401689
49	48200.86	55013.35	114133.56	9.6830548	9.7404681
50	48226.34	55051.25	114151.83	9.6832843	9.7407672
51	48251.82	55089.16	114170.12	9.6835137	9.7410662
52	48277.30	55127.08	114188.42	9.6837430	9.7413650
53	48302.77	55165.02	114206.74	9.6839720	9.7416638
54	48328.24	55202.97	114225.07	9.6842010	9.7419624
55	48353.70	55240.93	114243.42	9.6844297	9.7422609
56	48379.16	55278.90	114261.79	9.6846583	9.7425594
57	48404.62	55316.88	114280.17	9.6848868	9.7428577
58	48430.07	55354.88	114298.57	9.6851151	9.7431559
59	48455.52	55392.88	114316.98	9.6853432	9.7434540
60	48480.96	55430.90	114335.41	9.6855712	9.7437520

61 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
30	87881.71	184177.09	209573.85	9.9438985	10.2652356
29	87867.83	184049.39	209461.64	9.9438299	10.2649344
28	87853.94	183921.84	209349.57	9.9437612	10.2646333
27	87840.04	183794.42	209237.64	9.9436925	10.2643323
26	87826.13	183667.13	209125.84	9.9436238	10.2640315
25	87812.22	183539.99	209014.18	9.9435549	10.2637307
24	87798.30	183412.97	208902.65	9.9434861	10.2634301
23	87784.37	183286.10	208791.27	9.9434172	10.2631295
22	87770.43	183159.36	208680.02	9.9433482	10.2628291
21	87756.49	183032.75	208568.90	9.9432792	10.2625288
20	87742.54	182906.28	208457.92	9.9432102	10.2622286
19	87728.58	182779.94	208347.08	9.9431411	10.2619285
18	87714.62	182653.74	208236.37	9.9430720	10.2616286
17	87700.64	182527.67	208125.80	9.9430028	10.2613287
16	87686.66	182401.73	208015.36	9.9429335	10.2610290
15	87672.68	182275.93	207905.06	9.9428643	10.2607293
14	87658.68	182150.26	207794.89	9.9427949	10.2604298
13	87644.68	182024.73	207684.86	9.9427255	10.2601304
12	87630.67	181899.32	207574.96	9.9426561	10.2598311
11	87616.65	181774.05	207465.19	9.9425866	10.2595319
10	87602.62	181648.92	207355.56	9.9425171	10.2592328
9	87588.59	181523.91	207246.06	9.9424476	10.2589338
8	87574.55	181399.04	207136.70	9.9423779	10.2586350
7	87560.51	181274.30	207027.46	9.9423083	10.2583362
6	87546.45	181149.69	206918.36	9.9422386	10.2580376
5	87532.39	181025.21	206809.40	9.9421688	10.2577391
4	87518.32	180900.86	206700.56	9.9420990	10.2574406
3	87504.24	180776.64	206591.86	9.9420291	10.2571423
2	87490.16	180652.56	206483.28	9.9419592	10.2568441
1	87476.07	180528.60	206374.84	9.9418893	10.2565460
0	87461.97	180404.78	206266.53	9.9418193	10.2562480

29 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	48480.96	55430.90	114335.41	9.6855712	9.7437520
1	48506.40	55468.94	114353.85	9.6857991	9.7440499
2	48531.84	55506.98	114372.31	9.6860267	9.7443476
3	48557.27	55545.04	114390.78	9.6862542	9.7446453
4	48582.70	55583.11	114409.27	9.6864816	9.7449428
5	48608.12	55621.19	114427.78	9.6867088	9.7452403
6	48633.54	55659.29	114446.30	9.6869359	9.7455376
7	48658.95	55697.39	114464.84	9.6871628	9.7458349
8	48684.36	55735.51	114483.39	9.6873895	9.7461320
9	48709.77	55773.64	114501.96	9.6876161	9.7464290
10	48735.17	55811.79	114520.55	9.6878425	9.7467259
11	48760.57	55849.94	114539.15	9.6880688	9.7470227
12	48785.97	55888.11	114557.76	9.6882949	9.7473194
13	48811.36	55926.29	114576.39	9.6885209	9.7476160
14	48836.74	55964.48	114595.04	9.6887467	9.7479125
15	48862.12	56002.69	114613.70	9.6889723	9.7482089
16	48887.50	56040.91	114632.38	9.6891978	9.7485052
17	48912.88	56079.14	114651.08	9.6894232	9.7488013
18	48938.24	56117.38	114669.79	9.6896484	9.7490974
19	48963.61	56155.64	114688.52	9.6898734	9.7493934
20	48988.97	56193.91	114707.26	9.6900983	9.7496892
21	49014.33	56232.19	114726.02	9.6903231	9.7499650
22	49039.68	56270.48	114744.79	9.6905476	9.7502806
23	49065.03	56308.79	114763.58	9.6907721	9.7505762
24	49090.37	56347.10	114782.39	9.6909964	9.7508716
25	49115.72	56385.43	114801.21	9.6912205	9.7511669
26	49131.05	56423.78	114820.05	9.6914445	9.7514622
27	49166.38	56462.13	114838.90	9.6916683	9.7517573
28	49191.71	56500.50	114857.77	9.6918919	9.7520523
29	49217.04	56538.88	114876.65	9.6921155	9.7523472
30	49242.36	56577.28	114895.55	9.6923388	9.7526420

60 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang
60	87461.97	180404.78	206266.53	9.9418193	10.2562480
59	87447.86	180281.08	206158.36	9.9417492	10.2559501
58	87433.75	180157.51	206050.31	9.9416791	10.2556524
57	87419.63	180034.08	205942.39	9.9416090	10.2553547
56	87405.50	179910.77	205834.60	9.9415388	10.2550572
55	87391.37	179787.59	205726.95	9.9414685	10.2547597
54	87377.22	179664.54	205619.42	9.9413982	10.2544624
53	87363.07	179541.62	205512.03	9.9413279	10.2541651
52	87348.91	179418.83	205404.76	9.9412575	10.2538680
51	87334.75	179296.16	225297.62	9.9411871	10.2535710
50	87320.58	179173.62	205190.61	9.9411166	10.2532741
49	87306.40	179051.21	205083.73	9.9410161	10.2529773
48	87292.21	178928.93	204976.98	9.9409755	10.2526806
47	87278.01	178806.78	204870.36	9.9409048	10.2523840
46	87263.81	178684.75	204763.86	9.9408342	10.2520875
45	87249.60	178562.85	204657.50	9.9407634	10.2517911
44	87235.38	178441.07	204551.26	9.9406927	10.2514948
43	87221.16	178319.43	204445.15	9.9406219	10.2511987
42	87206.93	178197.90	204339.16	9.9405510	10.2509026
41	87192.69	178076.51	204233.30	9.9404801	10.2506066
40	87178.44	177955.24	204127.57	9.9404091	10.2503208
39	87164.19	177834.09	204021.97	9.9403381	10.2500150
38	87149.93	177713.07	203916.49	9.9402670	10.2497194
37	87135.66	177592.18	203811.14	9.9401959	10.2494238
36	87121.38	177471.41	203705.92	9.9401248	10.2491284
35	87107.10	177350.76	203600.82	9.9400535	10.2488331
34	87092.81	177230.24	203495.85	9.9399823	10.2485378
33	87078.51	177109.85	203391.00	9.9399110	10.2482427
32	87064.20	176989.58	203286.27	9.9398396	10.2479477
31	87649.89	176869.43	203181.68	9.9397682	10.2476528
30	87035.57	176749.40	203077.20	9.9396968	10.2473580

29 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	49242.36	56577.28	114895.55	9.6923388	9.7526420
31	49267.67	56615.68	114914.47	9.6925620	9.7529368
32	49292.98	56654.10	114933.40	9.6927851	9.7532314
33	49318.29	56692.53	114952.35	9.6930080	9.7535259
34	49343.59	56730.98	114971.32	9.6932308	9.7538203
35	49368.89	56769.44	114990.30	9.6934534	9.7541146
36	49394.19	56807.91	115009.30	9.6936758	9.7544088
37	49419.48	56846.39	115028.31	9.6938981	9.7547029
38	49444.76	56884.88	115047.34	9.6941203	9.7549969
39	49470.05	56923.39	115066.38	9.6943423	9.7552908
40	49495.32	56961.91	115085.44	9.6945642	9.7555846
41	49520.60	57000.45	115104.52	9.6947859	9.7558783
42	49545.87	57038.99	115123.61	9.6950074	9.7561718
43	49571.13	57077.55	115142.72	9.6952288	9.7564653
44	49596.39	57116.12	115161.85	9.6954501	9.7567587
45	49621.65	57154.71	115180.99	9.6956712	9.7570520
46	49646.90	57193.31	115200.15	9.6958922	9.7573452
47	49672.15	57231.92	115219.32	9.6961130	9.7576383
48	49697.40	57270.54	115238.51	9.6963336	9.7579313
49	49722.64	57309.18	115257.72	9.6965541	9.7582242
50	49747.87	57347.83	115276.94	9.6967745	9.7585170
51	49773.10	57386.49	115296.18	9.6969947	9.7588096
52	49798.33	57425.16	115315.43	9.6972148	9.7591022
53	49823.55	57463.85	115334.70	9.6974347	9.7593947
54	49848.77	57502.55	115353.99	9.6976545	9.7596871
55	49873.99	57541.26	115373.29	9.6978741	9.7599794
56	49899.20	57579.99	115392.61	9.6980936	9.7602716
57	49924.41	57618.73	115311.95	9.6983129	9.7605637
58	49949.61	57657.48	115431.30	9.6985321	9.7608557
59	49974.81	57696.25	115450.67	9.6987511	9.7611476
60	50000.00	57735.03	115470.05	9.6989700	9.7614394

60 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	87035.57	176740.40	203077.20	9.9396968	10.2473580
29	87021.24	176629.50	202972.86	9.9396253	10.2470632
28	87006.91	176509.72	202868.63	9.9395537	10.2467686
27	86992.56	176390.07	202764.53	9.9394821	10.2464741
26	86978.21	176270.53	202660.56	9.9394105	10.2461797
25	86963.86	176151.12	202556.70	9.9393388	10.2458854
24	86949.49	176031.83	202452.97	9.9392671	10.2455912
23	86935.12	175912.67	202349.37	9.9391953	10.2452971
22	86920.74	175793.62	202245.89	9.9391234	10.2450031
21	86906.35	175674.70	202142.53	9.9390515	10.2447092
20	86891.96	175555.90	202039.29	9.9389796	10.2444154
19	86877.56	175437.22	201936.17	9.9389076	10.2441217
18	86863.15	175318.66	201833.18	9.9388356	10.2438282
17	86848.73	175200.23	201730.31	9.9387635	10.2435347
16	86834.31	175081.91	201627.56	9.9386914	10.2432413
15	86819.88	174963.71	201524.94	9.9386192	10.2429480
14	86805.44	174845.64	201422.43	9.9385470	10.2426548
13	86791.00	174727.68	201320.05	9.9384747	10.2423617
12	86776.55	174609.84	201217.79	9 9384024	10.2420687
11	86762.09	174492.13	201115.64	9.9383300	10.2417758
10	86747.62	174374.53	201013.62	9.9382576	10.2414830
9	86733.14	174257.05	200911.72	9.9381851	10.2411904
8	86718.66	174139.69	200809.94	9.9381126	10.2408978
7	86704.17	174022.45	200708.28	9.9380400	10.2406053
6	86689.67	173905.33	200606.74	9.9379674	10.2403129
5	86675.17	173788.33	200505.32	9.9378947	10.2400206
4	86660.66	173671.44	200404.02	9.9378220	10.2397284
3	86646.14	173554.68	200302.83	9.9377492	10.2394363
2	86631.61	173438.03	200201.77	9.9376764	10.2391443
1	86617.08	173321.49	200100.83	9.9376035	10.2388524
0	86602.54	173205.08	200000.00	9.9375306	10.2385606

30 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	50000.00	57735.03	115470.05	9.6989700	9.7614394
1	50025.19	57773.82	115489.45	9.6991887	9.7617311
2	50050.37	57812.62	115508.87	9.6994073	9.7620227
3	50075.56	57851.44	115528.30	9.6996258	9.7623142
4	50100.73	57890.27	115547.75	9.6998441	9.7626056
5	50125.91	57929.11	115567.22	9.7000622	9.7628969
6	50151.07	57967.97	115586.70	9.7002802	9.7631881
7	50176.24	58006.84	115606.20	9.7004981	9.7634792
8	50201.40	58045.73	115625.72	9.7007158	9.7637702
9	50226.55	58084.62	115645.25	9.7009334	9.7640612
10	50251.70	58123.53	115664.80	9.7011508	9.7643520
11	50276.85	58162.45	115684.36	9.7013681	9.7646427
12	50301.99	58201.39	115703.94	9.7015852	9.7649334
13	50327.13	58240.34	115723.54	9.7018022	9.7652239
14	50352.27	58279.30	115743.15	9.7020190	9.7655143
15	50377.40	58318.28	115762.78	9.7022357	9.7658047
16	50402.52	58357.27	115782.43	9.7024523	9.7660949
17	50427.65	58396.27	115802.09	9.7026687	9.7663851
18	50452.76	58435.28	115821.77	9.7028849	9.7666751
19	50477.88	58474.31	115841.47	9.7031011	9.7669651
20	50502.98	58513.35	115861.18	9.7033170	9.7672550
21	50528.09	58552.41	115880.91	9.7035329	9.7675448
22	50553.19	58591.48	115900.65	9.7037486	9.7678344
23	50578.28	58630.56	115920.41	9.7039641	9.7681240
24	50603.38	58669.65	115940.19	9.7041795	9.7684135
25	50628.46	58708.76	115959.99	9.7043947	9.7687029
26	50653.55	58747.88	115979.80	9.7046099	9.7689922
27	50678.63	58787.02	115999.63	9.7048248	9.7692814
28	50703.70	58826.17	116019.47	9.7050397	9.7695705
29	50728.77	58865.33	116039.33	9.7052543	9.7698596
30	50753.84	58904.50	116059.21	9.7054689	9.7701485

59 Degrees.

Minutes.	Sines.	Tangents	Secants.	Log. Sin.	Log. Tang.
60	86602.54	173205.08	200000.00	9.9375306	10.2385606
59	86587.99	173088.78	199899.29	9.9374577	10.2382689
58	86573.44	172972.60	199798.70	9.9373847	10.2379773
57	86558.87	172856.54	199698.23	9.9373116	10.2376858
56	86544.30	172740.60	199597.88	9.9372385	10.2373944
55	86529.73	172624.77	199497.64	9.9371653	10.2371031
54	86515.14	172509.05	199397.53	9.9370921	10.2368119
53	86500.55	172393.45	199297.52	9.9370189	10.2365208
52	86485.95	172277.97	199197.64	9.9369456	10.2362298
51	86471.34	172162.61	199097.87	9.9368722	10.2359388
50	86456.73	172047.36	198998.22	9.9367988	10.2356480
49	86442.11	171932.22	198898.69	9.9367254	10.2353573
48	86427.48	171817.20	198799.27	9.9366519	10.2350666
47	86512.84	171702.30	198699.97	9.9365783	10.2347761
46	86398.20	171587.51	198600.80	9.9365047	10.2344857
45	86383.55	171472.83	198501.72	9.9364311	10.2341953
44	86368.89	171358.27	198402.76	9.9343576	10.2339051
43	86354.23	171243.82	198303.93	9.9362836	10.2336149
42	86339.56	171129.49	198205.20	9.9362098	10.2333249
41	86324.88	171015.27	198106.59	9.9361360	10.2330349
40	86310.19	170901.16	198008.10	9.9360621	10.2327450
39	86295.49	170787.17	197909.72	9.9359881	10.2324552
38	86280.79	170673.29	197811.46	9.9359141	10.2321656
37	86266.08	170559.53	197713.31	9.9358401	10.2318760
36	86251.37	170445.87	197615.27	9.9357660	10.2315865
35	86236.64	170332.33	197517.35	9.9356918	10.2312971
34	86221.91	170218.90	197419.54	9.9356177	10.2310078
33	86207.17	170105.59	197321.85	9.9355434	10.2307186
32	86192.43	169992.38	197224.26	9.9354691	10.2304295
31	86177.68	169879.29	197126.80	9.9353948	10.2301404
30	86162.92	169766.31	197029.44	9.9353204	10.2298515

30 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	50753.84	58904.50	116059.21	9.7054689	9.7701485
31	50778.90	58943.69	116079.11	9.7056833	9.7704373
32	50803.96	58982.89	116099.02	9.7058975	9.7707261
33	50829.01	59022.11	116118.95	9.7061116	9.7710147
34	50854.06	59061.34	116138.89	9.7063256	9.7713033
35	50879.10	59100.58	116158.85	9.7065394	9.7715917
36	50904.14	59139.83	116178.83	9.7067531	9.7718801
37	50929.18	59179.10	116198.82	9.7069667	9.7721684
38	50954.21	59218.39	116218.83	9.7071801	9.7724566
39	50979.24	59257.68	116238.86	9.7073933	9.7727447
40	51004.26	59296.99	116258.91	9.7076064	9.7730327
41	51029.28	59336.32	116278.97	9.7078194	9.7733206
42	51054.29	59375.66	116299.05	9.7080323	9.7736084
43	51079.30	59415.01	116319.14	9.7082450	9.7738961
44	51104.31	59454.37	116339.25	9.7084575	9.7741838
45	51129.31	59493.75	116359.38	9.7086699	9.7744713
46	51154.31	59533.14	116379.53	9.7088822	9.7747588
47	51179.30	59572.54	116399.69	9.7090943	9.7750462
48	51204.29	59611.96	116419.87	9.7093063	9.7753334
49	51229.27	59651.40	116440.07	9.7095182	9.7756206
50	51254.25	59690.84	116460.28	9.7097299	9.7759077
51	51279.22	59730.30	116480.51	9.7099415	9.7761947
52	51304.20	59769.78	116500.76	9.7101529	9.7764816
53	51329.16	59809.27	116521.02	9.7103642	9.7767685
54	51354.12	59848.77	116541.30	9.7105753	9.7770552
55	51379.08	59888.28	116561.00	9.7107863	9.7773418
56	51404.04	59927.81	116581.91	9.7109972	9.7776284
57	51428.99	59967.35	116602.24	9.7112080	9.7779149
58	51453.93	60006.91	116622.59	9.7114186	9.7782012
59	51478.87	60046.48	116642.96	9.7116290	9.7784875
60	51503.81	60086 06	116663.34	9.7118393	9.7787737

59 Degrees.

Minutes.	Sines.	Tangent.	Secants.	Log. Sin.	Log. Tang.
30	86162.92	169766.31	197029.44	9.9353204	10.2298515
29	86148.15	169653.44	196932.20	9.9352459	10.2295627
28	86133.37	169540.69	196835.07	9.9351715	10.2292739
27	86118.59	169428.04	196738.05	9.9350969	10.2289853
26	8610.380	169315.50	196641.14	9.9350223	10.2286967
25	86089.00	169203.08	196544.34	9.9349477	10.2284083
24	86074.20	169090.77	196447.67	9.9348730	10.2281199
23	86059.39	168978.56	196351.10	9.9347983	10.2278316
22	86044.57	168866.47	196254.64	9.9347235	10.2275434
21	86029.75	168754.49	196158.29	9.9346486	10.2272553
20	86014.91	168642.61	196062.06	9.9345738	10.2269673
19	86000.07	168530.85	195965.93	9.9344988	10.2266794
18	85985.23	168419.19	195869.92	9.9344238	10.2263916
17	85970.37	168307.65	195774.01	9.9343488	10.2261039
16	85955.51	168196.21	195678.22	9.9342737	10.2258162
15	85940.64	168084.89	195582.54	9.9341986	10.2255287
14	85925.76	167973.67	195486.97	9.9341234	10.2252412
13	85910.88	167862.56	195391.50	9.9340482	10.2249538
12	85895.99	167751.56	195296.15	9.9339729	10.2246666
11	85881.09	167640.67	195200.91	9.9338976	10.2243794
10	85866.18	167529.88	195105.77	9.9338222	10.2240923
09	85851.27	167419.21	195010.75	9.9337467	10.2238053
8	85836.35	167308.64	194915.83	9.9336713	10.2235184
7	85821.42	167198.18	194821.02	9.9335957	10.2232315
6	85806.49	167087.82	194726.32	9.9335201	10.2229448
5	85791.55	166977.58	194631.73	9.9334445	10.2226582
4	85776.60	166867.44	194537.25	9.9333688	10.2223716
3	85761.64	166757.41	194442.88	9.9332931	10.2220851
2	85746.68	166647.48	194348.61	9.9332173	10.2217988
1	85731.71	166537.66	194254.45	9.9331415	10.2215125
0	85716.73	166427.95	194160.40	9.9330656	10.2212263

31 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	51503.81	60086.06	116663.34	9.7118393	9.7787737
1	51528.74	60125.66	116683.74	9.7120495	9.7790599
2	51553.67	60165.27	116704.16	9.7122596	9.7793459
3	51578.59	60204.90	116724.59	9.7124695	9.7796318
4	51603.51	60244.54	116745.04	9.7126792	9.7799177
5	51628.42	60284.19	116765.51	9.7128889	9.7802034
6	51653.33	60323.86	116785.99	9.7130983	9.7804891
7	51678.24	60363.54	116806.49	9.7133077	9.7807747
8	51703.14	60403.23	116827.01	9.7135169	9.7810602
9	51728.04	60442.94	116847.55	9.7137260	9.7813456
10	51752.93	60482.66	116868.10	9.7139349	9.7816309
11	51777.82	60522.40	116888.67	9.7141437	9.7819162
12	51802.70	60562.15	116909.26	9.7143524	9.7822013
13	51827.58	60601.92	116929.86	9.7145609	9.7824864
14	51852.46	60641.70	116950.48	9.7147693	9.7827713
15	51877.33	60681.49	116971.12	9.7149776	9.7830562
16	51902.19	60721.30	116991.78	9.7151857	9.7833410
17	51927.05	60761.12	117012.45	9.7153937	9.7836258
18	51951.91	60800.95	117033.14	9.7156015	9.7839104
19	51976.76	60840.80	117053.85	9.7158092	9.7841949
20	52001.61	60880.67	117074.57	9.7160168	9.7844794
21	52026.46	60920.54	117095.31	9.7162243	9.7847938
22	52051.30	60960.43	117116.07	9.7164316	9.7850481
23	52076.13	61000.34	117136.85	9.7166387	9.7853323
24	52100.96	61040.26	117157.64	9.7168458	9.7856164
25	52125.79	61080.19	117178.45	9.7170526	9.7859004
26	52150.61	61120.14	117199.28	9.7172594	9.7861844
27	52175.43	61160.11	117220.13	9.7174660	9.7864682
28	52200.24	61200.08	117240.99	9.7176725	9.7867520
29	52225.05	61240.07	117261.87	9.7178789	9.7870357
30	52249.86	61280.08	117282.77	9.7180851	9.7873193

58 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	85716.73	166427.95	194160.40	9.9330656	10.2212263
59	85701.74	166318.34	194066.46	9.9329897	10.2209401
58	85686.75	166208.84	193972.62	9.9329137	10.2206541
57	85671.75	166099.45	193878.89	9.9328376	10.2203682
56	85656.74	165990.16	193785.27	9.9327616	10.2200623
55	85641.73	165880.97	193691.76	9.9326854	10.2197966
54	85626.71	165771.89	193598.35	9.9326092	10.2195109
53	85611.68	165662.92	193505.05	9.9325330	10.2192253
52	85596.64	165554.05	193411.85	9.9324567	10.2189398
51	85581.60	165445.29	193318.76	9.9323804	10.2186544
50	85566.55	165336.63	193225.78	9.9323040	10.2183691
49	85551.49	165228.08	193132.90	9.9322276	10.2180838
48	85536.43	165119.63	193040.13	9.9321511	10.2177987
47	85521.35	165011.28	192947.46	9.9320746	10.2175136
46	85506.27	164903.04	192854.90	9.9319980	10.2172287
45	85491.19	164794.90	192762.44	9.9319213	10.2169438
44	85476.09	164686.86	192670.09	9.9318447	10.2166590
43	85460.99	164578.93	192577.84	9.9317679	10.2163742
42	85445.88	164471.11	192485.70	9.9316911	10.2160896
41	85430.77	164363.38	192393.66	9.9316143	10.2158051
40	85415.64	164255.76	192301.73	9.9315374	10.2155206
39	85400.51	164148.24	192209.90	9.9314605	10.2152362
38	85385.38	164040.82	192118.17	9.9313835	10.2149519
37	85370.23	163933.51	192026.55	9.9313065	10.2146677
36	85355.08	163826.30	191935.03	9.9312294	10.2143836
35	85339.92	163719.19	191843.62	9.9311522	10.2140996
34	85324.75	163612.18	191752.30	9.9310750	10.2138156
33	85309.58	163505.28	191661.09	9.9309978	10.2135318
32	85294.40	163398.47	191569.99	9.9309205	10.2132480
31	85279.21	163291.77	191478.99	9.9308432	10.2129643
30	85264.02	163185.17	191388.09	9.9307658	10.2126807

31 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	52249.86	61280.08	117282.77	9.7180851	9.7873193
31	52274.66	61320.10	117303.69	9.7182912	9.7876028
32	52299.45	61360.13	117324.62	9.7184971	9.7878863
33	52324.24	61400.18	117345.57	9.7187030	9.7881696
34	52349.03	61440.24	117366.54	9.7189086	9.7884529
35	52373.81	61480.32	117387.52	9.7191142	9.7887361
36	5239.859	61520.41	117408.52	9.7193196	9.7890192
37	52423.36	61560.52	117429.54	9.7195249	9.7893023
38	52448.13	61600.64	117450.58	9.7197300	9.7895852
39	52472.90	61640.77	117471.64	9.7199350	9.7898681
40	52497.66	61680.92	117492.71	9.7201399	9.7901508
41	52522.41	61721.08	117513.80	9.7203447	9.7904335
42	52547.16	61761.26	117534.91	9.7205493	9.7907161
43	52571.91	61801.45	117556.03	9.7207538	9.7909987
44	52596.65	61841.66	117577.17	9.7209581	9.7912811
45	52621.39	61881.88	117598.33	9.7211623	9.7915635
46	52646.13	61922.11	117619.51	9.7213664	9.7918458
47	52670.85	61962.36	117640.70	9.7215704	9.7921280
48	52695.58	62002.63	117661.91	9.7217742	9.7924101
49	52720.30	62042.91	117683.14	9.7219779	9.7926921
50	52745.02	62083.20	117704.39	9.7221814	9.7929341
51	52769.73	62123.51	117725.66	9.7223848	9.7932560
52	52794.43	62163.83	117746.94	9.7225881	9.7935378
53	52819.14	62204.17	117768.24	9.7227913	9.7938195
54	52843.83	62244.52	117789.56	9.7229943	9.7941011
55	52868.53	62284.88	117810.90	9.7231972	9.7943827
56	52893.22	62325.26	117832.25	9.7234000	9.7946641
57	52917.90	62365.66	117853.62	9.7236026	9.7949455
58	52942.58	62406.07	117875.01	9.7238051	9.7952268
59	52967.26	62446.50	117896.42	9.7240075	9.7955081
60	52991.93	62486.94	117917.44	9.7242097	9.7957892

58 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	85264.02	163185.17	191388.09	9.9307658	10.2126807
29	85248.81	163078.67	191297.29	9.9306883	10.2123972
28	85233.60	162972.27	191206.59	9.9306109	10.2121137
27	85218.39	162865.97	191116.00	9.9305333	10.2118304
26	85203.16	162759.77	191025.51	9.9304557	10.2115471
25	85187.93	162653.68	190935.12	9.9303781	10.2112639
24	85172.69	162547.68	190844.83	9.9303004	10.2109808
23	85157.45	162441.78	190754.64	9.9302226	10.2106977
22	85142.19	162335.99	190664.56	9.9301448	10.2104148
21	85126.93	162230.29	190574.57	9.9300670	10.2101319
20	85111.67	162124.69	190484.69	9.9299891	10.2098492
19	85096.39	162019.20	190394.91	9.9299112	10.2095665
18	85081.11	161913.80	190305.22	9.9298332	10.2092839
17	85065.82	161808.50	190215.64	9.9297551	10.2090013
16	85050.53	161703.30	190126.16	9.9296770	10.2087189
15	85035.22	161598.20	190036.78	9.9295989	10.2084365
14	85019.91	161493.20	189947.50	9.9295207	10.2081542
13	85004.59	161388.29	189858.32	9.9294424	10.2078720
12	84989.27	161283.49	189769.24	9.9293641	10.2075899
11	84973.94	161178.78	189680.26	9.9292857	10.2073079
10	84958.60	161074.17	189591.38	9.9292073	10.2070259
9	84943.25	160969.66	189502.59	9.9291289	10.2067440
8	84927.90	160865.25	189413.91	9.9290504	10.2064622
7	84912.54	160760.94	189325.32	9.9289718	10.2061805
6	84897.17	160656.72	189236.84	9.9288932	10.2058989
5	84881.79	160552.60	189148.45	9.9288145	10.2056173
4	84866.41	160448.58	189060.16	9.9287358	10.2053359
3	84851.02	160344.65	188971.97	9.9286571	10.2050545
2	84835.62	160240.82	188883.88	9.9285783	10.2047732
1	84820.22	160137.09	188795.89	9.9284994	10.2044919
0	84804.81	160033.45	188707.99	9.9284205	10.2042108

32 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	52991.93	62486.94	117917.84	9.7242097	9.7957892
1	53016.59	62527.39	117939.28	9.7244118	9.7960703
2	53041.25	62567.86	117960.74	9.7246138	9.7963513
3	53065.91	62608.34	117982.22	9.7248156	9.7966322
4	53090.56	62648.84	118003.72	9.7250174	9.7969130
5	53115.21	62689.35	118025.23	9.7252189	9.7971938
6	53139.86	62729.88	118046.76	9.7254204	9.7974745
7	53164.50	62770.42	118068.31	9.7256217	9.7977551
8	53189.13	62810.98	118089.88	9.7258229	9.7980356
9	53213.76	62851.56	118111.47	9.7260240	9.7983160
10	53238.39	62892.15	118133.07	9.7262249	9.7985964
11	53263.01	62932.75	118154.69	9.7264257	9.7988767
12	53287.63	62973.36	118176.33	9.7266264	9.7991569
13	53312.24	63013.99	118197.99	9.7268269	9.7994370
14	53336.85	63054.64	118219.66	9.7270273	9.7997170
15	53361.45	63095.30	118241.35	9.7272276	9.7999970
16	53386.05	63135.98	118263.06	9.7274278	9.8002769
17	53410.64	63176.67	118284.79	9.7276278	9.8005567
18	53435.23	63217.38	118306.54	9.7278277	9.8008365
19	53459.82	63258.10	118328.30	9.7280275	9.8011161
20	53484.40	63298.83	118350.08	9.7282271	9.8013957
21	53508.98	63339.58	118371.88	9.7284267	9.8016752
22	53533.55	63380.35	118393.70	9.7286260	9.8019546
23	53558.12	63421.13	118415.54	9.7288253	9.8022340
24	53582.68	63461.93	118437.40	9.7290244	9.8025133
25	53607.24	63502.74	118459.27	9.7292234	9.8027925
26	53631.79	63543.57	118481.16	9.7294223	9.8030716
27	53656.34	63584.41	118503.07	9.7296211	9.8033506
28	53680.88	63625.27	118525.00	9.7298197	9.8036296
29	53705.42	63666.14	118546.94	9.7300182	9.8039085
30	53729.96	63707.03	118568.91	9.7302165	9.8041873

57 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	84804.81	160033.45	188707.99	9.9284205	10.2042108
59	84789.39	159929.91	188620.19	9.9283415	10.2039297
58	84773.97	159826.47	188532.49	9.9282625	10.2036487
57	84758.53	159723.12	188444.89	9.9281834	10.2033678
56	84743.09	159619.87	188357.38	9.9281043	10.2030870
55	84727.65	159516.72	188269.97	9.9280251	10.2028062
54	84712.19	159413.66	188182.66	9.9279459	10.2025255
53	84696.73	159310.70	188095.45	9.9278666	10.2022449
52	84681.26	159207.83	188008.33	9.9277873	10.2019644
51	84665.79	159105.05	187921.31	9.9277079	10.2016840
50	84650.30	159002.38	187834.38	9.9276285	10.2014036
49	84634.81	158899.79	187747.55	9.9275490	10.2011233
48	84619.32	158797.30	187660.82	9.9274695	10.2008431
47	84603.81	158694.91	187574.18	9.9273899	10.2005630
46	84588.30	158592.61	187487.64	9.9273103	10.2002830
45	84572.78	158490.41	187401.20	9.9272306	10.2000030
44	84557.26	158388.30	187314.85	9.9271509	10.1997231
43	84541.72	158286.28	187228.59	9.9270711	10.1994433
42	84526.19	158184.36	187142.43	9.9269913	10.1991635
41	84510.63	158082.53	187056.37	9.9269114	10.1988839
40	84495.08	157980.79	186970.40	9.9268314	10.1986043
39	84479.52	157879.15	186884.53	9.9267514	10.1983248
38	84463.95	157777.60	186798.75	9.9266714	10.1980454
37	84448.38	157676.15	186713.06	9.9265913	10.1977660
36	84432.79	157574.79	186627.47	9.9265112	10.1974867
35	84417.20	157473.52	186541.97	9.9264310	10.1972075
34	84401.60	157372.34	186456.57	9.9263507	10.1969284
33	84386.00	157271.26	186371.26	9.9262704	10.1966494
32	84370.39	157170.26	186286.05	9.9261901	10.1963704
31	84354.77	157069.36	186200.93	9.9261096	10.1960915
30	84339.14	157968.56	186115.90	9.9260292	10.1958127

32 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	53729.96	63707.03	118568.91	9.7302165	9.8041873
31	53754.49	63747.93	118590.89	9.7304148	9.8044661
32	53779.02	63788.85	118612.89	9.7306129	9.8047447
33	53803.54	63829.78	118634.91	9.7308109	9.8050233
34	53828.06	63870.73	118656.95	9.7310087	9.8053019
35	53852.57	63911.69	118679.00	9.7312064	9.8055803
36	53877.08	63952.67	118701.07	9.7314040	9.8058587
37	53901.58	63993.66	118723.16	9.7316015	9.8061370
38	53926.08	64034.67	118745.27	9.7317989	9.8064152
39	53950.58	64075.69	118767.40	9.7319961	9.8066933
40	53975.07	64116.73	118789.55	9.7321932	9.8069714
41	53999.55	64157.79	118811.71	9.7323902	9.8072494
42	54024.03	64198.86	118833.89	9.7325870	9.8075273
43	54048.51	64239.95	118856.09	9.7327837	9.8078052
44	54072.98	64281.05	118878.31	9.7329803	9.8080829
45	54097.45	64322.16	118900.55	9.7331768	9.8083606
46	54121.91	64363.29	118922.81	9.7333731	9.8086383
47	54146.37	64404.44	118945.08	9.7335693	9.8089158
48	54170.82	64445.60	118967.37	9.7337654	9.8091933
49	54195.27	64486.78	118989.68	9.7339614	9.8094707
50	54219.71	64527.97	119012.01	9.7341572	9.8097480
51	54244.15	64569.18	119034.36	9.7343529	9.8100253
52	54268.59	64610.41	119056.73	9.7345485	9.8103025
53	54293.02	64651.65	119079.12	9.7347440	9.8105796
54	54317.44	64692.90	119101.52	9.7349393	9.8108566
55	54341.87	64734.17	119123.94	9.7351345	9.8111336
56	54366.28	64775.46	119146.38	9.7353296	9.8114105
57	54390.69	64816.76	119168.84	9.7355246	9.8116873
58	54415.10	64858.08	119191.32	9.7357195	9.8119641
59	54439.50	64899.41	119213.82	9.7359142	9.8122408
60	54463.90	64940.76	119236.33	9.7361088	9.8125174

57 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	84339.14	156968.56	186115.90	9.9260292	10.1958127
29	84323.51	156867.84	186030.96	9.9259487	10.1955339
28	84307.87	156767.22	185946.12	9.9258681	10.1952553
27	84292.22	156666.69	185861.38	9.9257875	10.1949767
26	84276.57	156566.25	185776.72	9.9257069	10.1946981
25	84260.91	156465.90	185692.16	9.9256261	10.1944197
24	84245.24	156365.64	185607.69	9.9255454	10.1941413
23	84229.56	156265.48	185523.31	9.9254646	10.1938630
22	84213.88	156165.40	185439.03	9.9253837	10.1935848
21	84198.19	156065.42	185354.83	9.9253028	10.1933067
20	84182.49	155965.52	185270.73	9.9252218	10.1930286
19	84166.79	155865.72	185186.72	9.9251408	10.1927506
18	84151.08	155766.01	185102.81	9.9250597	10.1924727
17	84135.36	155666.39	185018.98	9.9249786	10.1921948
16	84119.63	155566.85	184935.25	9.9248974	10.1919171
15	84103.90	155467.41	184851.61	9.9248161	10.1916394
14	84088.16	155368.06	184768.05	9.9247349	10.1913617
13	84072.41	155268.80	184684.59	9.9246535	10.1910842
12	84056.66	155169.63	184601.23	9.9245721	10.1908067
11	84040.90	155070.54	184517.95	9.9244907	10.1905293
10	84025.13	154971.55	184434.76	9.9244092	10.1902520
9	84009.35	154872.64	184351.66	9.9243277	10.1899747
8	83993.57	154773.83	184268.66	9.9242461	10.1896975
7	83977.78	154675.10	184185.74	9.9241644	10.1894204
6	83961.99	154576.46	184102.92	9.9240827	10.1891434
5	83946.18	154477.92	184020.18	9.9240010	10.1888664
4	83930.37	154379.46	183937.53	9.9239191	10.1885895
3	83914.55	154281.08	183854.98	9.9238373	10.1883127
2	83898.73	154182.80	183772.51	9.9237554	10.1880359
1	83882.90	154084.60	183690.13	9.9236734	10.1877592
0	83867.06	153986.50	183607.84	9.9235914	10.1874826

33 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	54463.90	64940.76	119236.33	9.7361088	9.8125174
1	54488.30	64982.12	119258.86	9.7363032	9.8127939
2	54512.69	65023.50	119281.41	9.7364976	9.8130704
3	54537.07	65064.90	119303.98	9.7366918	9.8133468
4	54561.45	65106.31	119326.57	9.7368859	9.8136231
5	54585.83	65147.74	119349.18	9.7370799	9.8138993
6	54610.20	65189.18	119371.81	9.7372737	9.8141755
7	54634.56	65230.64	119394.46	9.7374675	9.8144516
8	54658.92	65272.11	119417.12	9.7376611	9.8147277
9	54683.28	65313.60	119439.80	9.7378546	9.8150036
10	54707.63	65355.11	119462.50	9.7380479	9.8152795
11	54731.98	65396.63	119485.22	9.7382412	9.8155554
12	54756.32	65438.17	119507.96	9.7384343	9.8158311
13	54780.66	65479.72	119530.72	9.7386273	9.8161068
14	54804.99	65521.29	119553.50	9.7388201	9.8163824
15	54829.32	65562.87	119576.30	9.7390129	9.8166580
16	54853.65	65604.47	119599.11	9.7392055	9.8169335
17	54877.97	65646.09	119621.94	9.7393980	9.8172089
18	54902.28	65687.72	119644.79	9.7395904	9.8174842
19	54926.59	65729.37	119667.66	9.7397827	9.8177595
20	54950.90	65771.03	119690.55	9.7399748	9.8180347
21	54975.20	65812.71	119713.46	9.7401668	9.8183098
22	54999.50	65854.41	119736.39	9.7403587	9.8185849
23	55023.79	65896.12	119759.34	9.7405505	9.8188599
24	55048.07	65937.85	119782.31	9.7407421	9.8191348
25	55072.36	65979.59	119805.29	9.7409337	9.8194096
26	55096.63	66021.35	119828.29	9.7411251	9.8196844
27	55120.91	66063.13	119851.31	9.7413164	9.8199592
28	55145.18	66104.92	119874.35	9.7415075	9.8202338
29	55169.44	66146.73	119897.41	9.7416986	9.8205084
30	55193.70	66188.56	119920.49	9.7418895	9.8207829

56 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log.* *Sin.*	*Log.* *Tang.*
60	83867.06	153986.50	183607.84	9.9235914	10.1874826
59	83851.21	15388.848	183525.64	9.9235093	10.1872061
58	83835.36	153790.55	183443.53	9.9234272	10.1869296
57	83819.50	153692.70	183361.51	9.9233450	10.1866532
56	83803.63	153594.94	183279.58	9.9232628	10.1863769
55	83787.75	153497.27	183197.74	9.9231805	10.1861007
54	83771.87	153399.69	183115.99	9.9230982	10.1858245
53	83755.98	153302.20	183034.32	9.9230158	10.1855484
52	83740.09	153204.79	182952.74	9.9229334	10.1852723
51	83724.18	153107.47	182871.25	9.9228509	10.1849964
50	83708.27	153010.23	182789.85	9.9227684	10.1847205
49	83692.36	152913.08	182708.54	9.9226858	10.1844446
48	83676.43	152816.02	182627.31	9.9226032	10.1841689
47	83660.50	152719.04	182546.17	9.9225205	10.1838932
46	83644.56	152622.15	182465.12	9.9224377	10.1836176
45	83628.62	152525.35	182384.16	9.9223549	10.1833420
44	83612.66	152428.63	182303.28	9.9222721	10.1830665
43	83596.70	152332.00	182222.49	9.9221891	10.1827911
42	83580.74	152235.45	182141.79	9.9221062	10.1825158
41	83564.76	152138.99	182061.18	9.9220232	10.1822405
40	83548.78	152042.61	181980.65	9.9219401	10.1819653
39	83532.79	151946.32	181900.21	9.9218570	10.1816902
38	83516.80	151850.12	181819.85	9.9217738	10.1814151
37	83500.80	151754.00	181739.58	9.9216906	10.1811401
36	83484.79	151657.96	181659.40	9.9216073	10.1808652
35	83468.77	151562.01	181579.30	9.9215240	10.1805904
34	83452.75	151466.14	181499.29	9.9214406	10.1803156
33	83436.72	151370.36	181419.37	9.9213572	10.1800408
32	83420.68	151274.66	181339.53	9.9212737	10.1797662
31	83404.63	151179.05	181259.77	9.9211902	10.1794916
30	83388.58	151083.52	181180.10	9.9211066	10.1792171

33 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	55193.70	66188.56	119920.49	9.7418895	9.8207829
31	55217.95	66230.40	119943.59	9.7420803	9.8210574
32	55242.20	66272.26	119966.71	9.7422710	9.8213317
33	55266.45	66314.13	119989.85	9.7424616	9.8216060
34	55290.69	66356.02	120013.01	9.7426520	9.8218803
35	55314.92	66397.92	120036.19	9.7428423	9.8221545
36	55339.15	66439.84	120059.38	9.7430325	9.8224286
37	55363.38	66481.78	120082.59	9.7432226	9.8227026
38	55387.60	66523.73	120105.82	9.7434126	9.8229766
39	55411.82	66565.70	120129.07	9.7436024	9.8232505
40	55436.03	66607.69	120152.34	9.7437921	9.8235244
41	55460.24	66649.69	120175.63	9.7439817	9.8237981
42	55484.44	66691.71	120198.94	9.7441712	9.8240719
43	55508.64	66733.75	120222.27	9.7443606	9.8243455
44	55532.83	66775.80	120245.62	9.7445498	9.8246191
45	55557.02	66817.87	120268.99	9.7447390	9.8248926
46	55581.21	66859.95	120292.37	9.7449280	9.8251660
47	55605.39	66902.05	120315.77	9.7451169	9.8254394
48	55629.56	66944.17	120339.19	9.7453056	9.8257127
49	55653.73	66986.30	120362.64	9.7454943	9.8259860
50	55677.90	67028.45	120386.10	9.7456828	9.8262592
51	55702.06	67070.62	120409.58	9.7458712	9.8265323
52	55726.21	67112.80	120433.08	9.7460595	9.8268053
53	55750.36	67155.00	120456.60	9.7462477	9.8270783
54	55774.51	67197.21	120480.14	9.7464358	9.8273513
55	55798.65	67239.44	120503.70	9.7466237	9.8276241
56	55822.79	67281.69	120527.28	9.7468115	9.8278969
57	55846.92	67323.96	120550.88	9.7469992	9.8281696
58	55871.05	67366.24	120574.50	9.7471868	9.8284423
59	55895.17	67408.54	120598.14	9.7473743	9.8287149
60	55919.29	67450.85	120621.80	9.7475617	9.8289874

56 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	83388.58	151083.52	181180.10	9.9211066	10.1792171
29	83372.52	150988.07	181100.52	9.9210229	10.1789426
28	83356.46	150892.71	181021.02	9.9209393	10.1786683
27	83340.38	150797.43	180941.61	9.9208555	10.1783940
26	83324.30	150702.24	180862.28	9.9207717	10.1781197
25	83308.22	150607.13	180783.04	9.9206878	10.1778455
24	83292.12	150512.10	180703.88	9.9206039	10.1775714
23	83276.02	150417.16	180624.81	9.9205200	10.1772974
22	83259.91	150322.30	180545.82	9.9204360	10.1770234
21	83243.80	150227.52	180466.91	9.9203519	10.1767495
20	83227.68	150132.82	180388.09	9.9202678	10.1764756
19	83211.55	150038.20	180309.35	9.9201836	10.1762019
18	83195.41	149943.67	180230.70	9.9200994	10.1759281
17	83179.27	149849.22	180152.13	9.9200151	10.1756545
16	83163.12	149754.86	180073.65	9.9199308	10.1753809
15	83146.96	149660.58	179995.25	9.9198464	10.1751074
14	83130.80	149566.38	179916.93	9.9197619	10.1748340
13	83114.62	149472.26	179838.69	9.9196775	10.1745606
12	83098.45	149378.22	179760.54	9 9195929	10.1742873
11	83082.26	149284.26	179682.47	9.9195083	10.1740140
10	83066.07	149190.38	179604.48	9.9194237	10.1737408
9	83049.87	149096.59	179526.58	9.9193390	10.1734677
8	83033.66	149002.88	179448.76	9.9192542	10.1731947
7	83017.45	148909.25	179371.02	9.9191694	10.1729217
6	83001.23	148815.70	179293.37	9.9190845	10.1726487
5	82985.00	148722.23	179215.80	9.9189996	10.1723759
4	82968.77	148628.84	179138.31	9.9189146	10.1721031
3	82952.52	148535.53	179060.90	9.9188296	10.1718304
2	82936.28	148442.30	178983.58	9.9187445	10.1715577
1	82920.02	148349.16	178906.33	9.9186594	10.1712851
0	82903.76	148256.10	178829.16	9.9185742	10.1710126

34 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	55919.29	67450.85	120621.80	9.7475617	9.8289874
1	55943.40	67493.18	120645.48	9.7477489	9.8292599
2	55967.51	67535.53	120669.18	9.7479360	9.8295323
3	55991.62	67577.90	120692.89	9.7481230	9.8298047
4	56015.71	67620.28	120716.62	9.7483099	9.8300769
5	56039.81	67662.68	120740.37	9.7484967	9.8303492
6	56063.90	67705.09	120764.14	9.7486833	9.8306213
7	56087.98	67747.52	120787.93	9.7488698	9.8308934
8	56112.06	67789.97	120811.75	9.7490562	9.8311654
9	56136.14	67832.44	120835.59	9.7492425	9.8314374
10	56160.21	67874.92	120859.44	9.7494287	9.8317093
11	56184.28	67917.42	120883.31	9.7496148	9.8319811
12	56208.34	67959.93	120907.20	9.7498007	9.8322529
13	56232.39	68002.46	120931.12	9.7499866	9.8325246
14	56256.44	68045.01	120955.05	9.7501723	9.8327963
15	56280.49	68087.58	120979.00	9.7503579	9.8330679
16	56304.53	68130.16	121002.97	9.7505434	9.8333394
17	56328.57	68172.76	121026.96	9.7507287	9.8336109
18	56352.60	68215.38	121050.97	9.7509140	9.8338823
19	56376.63	68258.01	121075.00	9.7510991	9.8341536
20	56400.66	68300.66	121099.05	9.7512842	9.8344249
21	56424.67	68343.33	121123.12	9.7514691	9.8346961
22	56448.69	68386.01	121147.21	9.7516538	9.8349673
23	56472.70	68428.71	121171.32	9.7518385	9.8352384
24	56496.70	68471.43	121195.45	9.7520231	9.8355094
25	56520.70	68514.17	121219.60	9.7522075	9.8357804
26	56544.69	68556.92	121243.77	9.7523919	9.8360513
27	56568.68	68599.69	121267.96	9.7525761	9.8363221
28	56592.67	68642.47	121292.17	9.7527602	9.8365929
29	56616.65	68685.27	121316.40	9.7529442	9.8368636
30	56640.62	68728.10	121340.64	9.7531280	9.8371343

55 Degrees.

Minutes.	Sines.	Tangents	Secants.	Log. Sin.	Log. Tang
60	82903.76	148256.10	178829.16	9.9185742	10.1710126
59	82887.49	148163.11	178752.08	9.9184890	10.1707401
58	82871.21	148070.21	178675.08	9.9184037	10.1704677
57	82854.93	147977.38	178598.17	9.9183183	10.1701953
56	82838.64	147884.63	178521.33	9.9182329	10.1699231
55	82822.34	147791.97	178444.57	9.9181475	10.1696508
54	82806.03	147699.38	178367.90	9.9180620	10.1693787
53	82789.72	147606.88	178291.31	9.9179764	10.1691066
52	82773.40	147514.45	178214.79	9.9178908	10.1688346
51	82757.07	147422.10	178138.36	9.9178051	10.1685626
50	82740.74	147329.83	178062.01	9.9177194	10.1682907
49	82724.40	147237.64	177985.74	9.9176336	10.1680189
48	82708.06	147145.53	177909.55	9.9175478	10.1677471
47	82691.70	147053.50	177833.43	9.9174619	10.1674754
46	82675.34	146961.55	177757.40	9.9173760	10.1672037
45	82658.97	146869.67	177681.45	9.9172900	10.1669321
44	82642.60	146777.87	177605.58	9.9172040	10.1666606
43	82626.22	146686.16	177529.79	9.9171179	10.1663891
42	82609.83	146594.52	177454.08	9.9170317	10.1661177
41	82593.43	146502.96	177378.45	9.9169455	10.1658464
40	82577.03	146411.47	177302.90	9.9168593	10.1655751
39	82560.62	146320.07	177227.43	9.9167730	10.1653039
38	82544.20	146228.74	177152.04	9.9166866	10.1650327
37	82527.78	146137.49	177076.73	9.9166002	10.1647616
36	82511.35	146046.32	177001.49	9.9165137	10.1644906
35	82494.91	145955.22	176926.33	9.9164272	10.1642196
34	82478.47	145864.20	176851.25	9.9163406	10.1639487
33	82462.02	145773.26	176776.25	9.9162539	10.1636779
32	82445.56	145682.40	176701.33	9.9161673	10.1634071
31	82429.09	145591.61	176626.49	9.9160805	10.1631364
30	82412.62	145500.90	176551.73	9.9159937	10.1628657

34 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	56640.62	68728.10	121340.64	9.7531280	9.8371343
31	56664.59	68770.94	121364.91	9.7533118	9.8374049
32	56688.56	68813.79	121389.20	9.7534954	9.8376755
33	56612.52	68856.66	121413.51	9.7536790	9.8379460
34	56736.48	68899.55	121437.83	9.7538624	9.8382164
35	56760.43	68942.46	121462.18	9.7540457	9.8384867
36	56784.37	68985.38	121486.55	9.7542288	9.8387571
37	56808.32	69028.32	121510.94	9.7544119	9.8390273
38	56832.25	69071.28	121535.35	9.7545949	9.8392975
39	56856.18	69114.25	121559.78	9.7547777	9.8395676
40	56880.11	69157.24	121584.23	9.7549604	9.8398377
41	56904.03	69200.25	121608.70	9.7551431	9.8401077
42	56927.95	69243.28	121633.19	9.7553256	9.8403776
43	56951.86	69286.33	121657.70	9.7555080	9.8406475
44	56975.77	69329.39	121682.23	9.7556902	9.8409174
45	56999.68	69372.47	121706.78	9.7558724	9.8411871
46	57023.57	69415.57	121731.35	9.7560544	9.8414569
47	57047.47	69458.68	121755.94	9.7562364	9.8417265
48	57071.36	69501.81	121780.55	9.7564182	9.8419961
49	57095.24	69544.96	121805.18	9.7565999	9.8422657
50	57119.12	69588.13	121829.83	9.7567815	9.8425351
51	57142.99	69631.31	121854.50	9.7569630	9.8428046
52	57166.86	69674.51	121879.19	9.7571444	9.8430739
53	57190.73	69717.73	121903.90	9.7573256	9.8433432
54	57214.59	69760.97	121928.64	9.7575068	9.8436125
55	57238.44	69804.22	121953.39	9.7576878	9.8438817
56	57262.29	69847.49	121978.16	9.7578687	9.8441508
57	57288.14	69890.78	122002.96	9.7580495	9.8444199
58	57309.98	69934.09	122027.77	9.7582302	9.8446889
59	57333.81	69977.41	122052.60	9.7584108	9.8449579
60	57357.64	70020.75	122077.46	9.7585913	9.8452268

55 Degrees.

Minutes.	Sines.	Tangent.	Secants.	Log. Sin.	Log. Tang.
30	82412.62	145500.90	176551.73	9.9159937	10.1628657
29	82396.14	145410.27	176477.04	9.9159069	10.1625951
28	82379.65	145319.71	176402.43	9.9158200	10.1623245
27	82363.16	145229.23	176327.91	9.9157330	10.1620540
26	82346.66	145138.83	176253.45	9.9156460	10.1617836
25	82330.15	145048.50	176179.08	9.9155589	10.1615133
24	82313.64	144958.25	176104.78	9.9154718	10.1612429
23	82297.12	144568.08	176030.56	9.9153846	10.1609727
22	82280.59	144777.98	175956.42	9.9152974	10.1607025
21	82264.05	144687.96	175882.36	9.9152101	10.1604324
20	82247.51	144598.01	175808.37	9.9151228	10.1601623
19	82230.96	144508.14	175734.46	9.9150354	10.1598923
18	82214.40	144418.34	175660.63	9.9149479	10.1596224
17	82197.84	144328.62	175586.87	9.9148604	10.1593525
16	82181.27	144238.97	175513.19	9.9147729	10.1590826
15	82164.69	144149.40	175439.59	9.9146852	10.1588129
14	82148.11	144059.91	175366.07	9.9145976	10.1585431
13	82131.52	143970.49	175292.62	9.9145099	10.1582735
12	82114.92	143881.14	175219.24	9.9144221	10.1580039
11	82098.32	143791.87	175145.94	9.9143342	10.1577343
10	82081.70	143702.68	175072.73	9.9142464	10.1574649
09	82065.08	143613.56	174999.58	9.9141584	10.1571954
8	82048.46	143524.51	174926.51	9.9140704	10.1569261
7	82031.83	143435.54	174853.52	9.9139824	10.1566568
6	82015.19	143346.64	174780.60	9.9138943	10.1563875
5	81998.54	143257.81	174707.76	9.9138061	10.1561183
4	81981.89	143169.06	174634.99	9.9137179	10.1558492
3	81965.23	143080.39	174562.30	9.9136296	10.1555801
2	81948.56	142991.78	174489.69	9.9135413	10.1553111
1	81931.89	142903.26	174417.15	9.9134530	10.1550421
0	81915.20	142814.80	174344.68	9.9133645	10.1547732

35 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	57357.64	70020.75	122077.46	9.7585913	9.8452268
1	57381.47	70064.11	122102.33	9.7587717	9.8454956
2	57405.29	70107.49	122127.23	9.7589519	9.8457644
3	57429.11	70150.89	122152.15	9.7591321	9.8460332
4	57452.92	70194.30	122177.08	9.7593121	9.8463018
5	57476.72	70237.73	122202.04	9.7594920	9.8465705
6	57500.52	70281.18	122227.02	9.7596718	9.8468390
7	57524.32	70324.65	122252.02	9.7598515	9.8471075
8	57548.11	70368.13	122277.03	9.7600311	9.8473760
9	57571.90	70411.63	122302.07	9.7602106	9.8476444
10	57595.68	70455.15	122327.13	9.7603899	9.8479127
11	57619.46	70498.69	122352.21	9.7605692	9.8481810
12	57643.23	70542.24	122377.32	9.7607483	9.8484492
13	57667.00	70585.81	122402.44	9.7609274	9.8487174
14	57690.76	70629.40	122427.58	9.7611063	9.8489855
15	57714.52	70673.01	122452.74	9.7612851	9.8492536
16	57738.27	70716.64	122477.93	9.7614638	9.8495216
17	57762.02	70760.29	122503.13	9.7616424	9.8497896
18	57785.76	70803.95	122528.36	9.7618208	9.8500575
19	57809.50	70847.63	122553 61	9.7619992	9.8503253
20	57833.23	70891.33	122578.87	9.7621775	9.8505931
21	57856.96	70935.05	122604.16	9.7623556	9.8508608
22	57880.68	70978.78	122629.47	9.7625337	9.8511285
23	57904.40	71022.53	122654.80	9.7627116	9.8513961
24	57928.12	71066.30	122680.15	9.7628894	9.8516637
25	57951.83	71110.09	122705.52	9.7630671	9.8519312
26	57975.53	71153.90	122730.91	9.7632447	9.8521987
27	57999.23	71197.73	122756.33	9.7634222	9.8524661
28	58022.92	71241.57	122781.76	9.7635996	9.8527335
29	58046.61	71285.43	122807.21	9.7637769	9.8530008
30	58070.30	71329.31	122832.69	9.7639540	9.8532680

54 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
60	81915.20	142814.80	174344.68	9.9133645	10.1547732
59	81898.52	142726.42	174272.29	9.9132760	10.1545044
58	81881.82	142638.11	174199.97	9.9131875	10.1542356
57	81865.12	142549.87	174127.73	9.9130989	10.1539668
56	81848.41	142461.71	174055.56	9.9130102	10.1536982
55	81831.69	142373.62	173983.47	9.9129215	10.1534295
54	81814.97	142285.61	173911.45	9.9128328	10.1531610
53	81798.24	142197.66	173839.51	9.9127440	10.1528925
52	81781.50	142109.79	173767.64	9.9126551	10.1526240
51	81764.76	142022.00	173695.85	9.9125662	10.1523556
50	81748.01	141934.27	173624.13	9.9124772	10.1520873
49	81731.25	141846.62	173552.47	9.9123882	10.1518190
48	81714.49	141759.04	173480.90	9.9122991	10.1515508
47	81697.72	141671.53	173409.41	9.9122099	10.1512826
46	81680.94	141584.09	173337.98	9.9121207	10.1510145
45	81664.16	141496.73	173266.63	9.9120315	10.1507464
44	81647.36	141409.43	173195.35	9.9119422	10.1504784
43	81630.56	141322.21	173124.14	9.9118528	10.1502104
42	81613.76	141235.06	173053.01	9.9117634	10.1499425
41	81596.95	141147.99	172981.95	9.9116739	10.1496747
40	81580.13	141060.98	172910.96	9.9115844	10.1494069
39	81563.30	140974.05	172840.05	9.9114948	10.1491392
38	81546.47	140887.18	172769.21	9.9114051	10.1488715
37	81529.63	140800.39	172698.44	9.9113155	10.1486039
36	81512.78	140713.67	172627.74	9.9112257	10.1483363
35	81495.93	140627.02	172557.12	9.9111359	10.1480688
34	81479.06	140540.44	172486.57	9.9110460	10.1478013
33	81462.20	140453.93	172416.09	9.9109561	10.1475339
32	81445.32	140367.49	172345.68	9.9108661	10.1472665
31	81428.44	140281.13	172275.34	9.9107761	10.1469992
30	81411.55	140194.83	172205.08	9.9106860	10.1467320

35 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	58070.30	71329.31	122832.69	9.7639540	9.8532680
31	58093.97	71373.21	122858.19	9.7641311	9.8535352
32	58117.65	71417.13	122883.71	9.7643080	9.8538023
33	58141.32	71461.06	122909.25	9.7644849	9.8540694
34	58164.98	71505.01	122934.81	9.7646616	9.8543365
35	58188.64	71548.98	122960.39	9.7648382	9.8546034
36	58212.30	71592.97	122985.99	9.7650147	9.8548704
37	58235.95	71636.98	123011.61	9.7651911	9.8551372
38	58259.59	71681.01	123037.25	9.7653674	9.8554041
39	58283.23	71725.05	123062.92	9.7655436	9.8556708
40	58306.87	71769.11	123088.61	9.7657197	9.8559376
41	58330.50	71813.19	123114.32	9.7658957	9.8562042
42	58354.12	71857.29	123140.05	9.7660715	9.8564708
43	58377.74	71901.41	123165.80	9.7662473	9.8567374
44	58401.36	71945.55	123191.57	9.7664229	9.8570039
45	58424.97	71989.70	123217.36	9.7665985	9.8572704
46	58448.57	72033.87	123243.17	9.7667739	9.8575368
47	58472.17	72078.06	123269.00	9.7669492	9.8578031
48	58495.77	72122.27	123294.86	9.7671244	9.8580694
49	58519.36	72166.50	123320.74	9.7672996	9.8583357
50	58542.94	72210.75	123346.64	9.7674746	9.8586019
51	58566.52	72255.02	123372.56	9.7676494	9.8588680
52	58590.10	72299.31	123398.50	9.7678242	9.8591341
53	58613.67	72343.61	123424.46	9.7679989	9.8594002
54	58637.24	72387.93	123450.44	9.7681735	9.8596661
55	58660.80	72432.27	123476.45	9.7683480	9.8599321
56	58684.35	72476.63	123502.48	9.7685223	9.8601980
57	58707.90	72521.01	123528.52	9.7686966	9.8604638
58	58731.45	72565.41	123554.59	9.7688707	9.8607296
59	58754.99	72609.83	123580.68	9.7690448	9.8609954
60	58778.53	72654.26	123606.80	9.7692187	9.8612610

54 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	81411.55	140194.83	172205.08	9.9106860	10.1467320
29	81394.65	140108.60	172134.89	9.9105959	10.1464648
28	81377.75	139022.45	172064.77	9.9105057	10.1461977
27	81360.84	139936.36	171994.72	9.9104155	10.1459306
26	81343.93	139850.34	171924.75	9.9103251	10.1456635
25	81327.01	139764.40	171854.84	9.9102348	10.1453966
24	81310.08	139678.52	171785.01	9.9101444	10.1451296
23	81293.14	139592.72	171715.25	9.9100539	10.1448638
22	81276.20	139506.98	171645.56	9.9099634	10.1445959
21	81259.25	139421.31	171575.94	9.9098728	10.1443292
20	81242.29	139335.71	171506.39	9.9097821	10.1440624
19	81225.32	139250.18	171436.91	9.9096915	10.1437958
18	81208.35	139164.73	171367.50	9.9096007	10.1435292
17	81191.37	139079.34	171298.17	9.9095099	10.1432626
16	81174.39	138994.01	171228.90	9.9094190	10.1429961
15	81157.40	138908.79	171159.70	9.9093281	10.1427296
14	81140.40	138823.58	171090.58	9.9092371	10.1424632
13	81123.39	138738.46	171021.52	9.9091461	10.1421969
12	81106.38	138653.42	170952.54	9.9090550	10.1419306
11	81089.36	138568.44	170883.62	9.9089639	10.1416643
10	81072.34	138483.53	170814.78	9.9088727	10.1413981
9	81055.30	138398.69	170746.00	9.9087814	10.1411320
8	81038.26	138313.92	170677.30	9.9086901	10.1408659
7	81021.22	138229.22	170608.66	9.9085988	10.1405998
6	81004.16	138144.58	170540.10	9.9085073	10.1403339
5	80987.10	138060.01	170471.60	9.9084159	10.1400679
4	80970.04	137975.51	170403.18	9.9083243	10.1398020
3	80952.96	137891.08	170334.82	9.9082327	10.1395362
2	80935.88	137806.72	170266.53	9.9081411	10.1392704
1	80918.79	137722.42	170198.31	9.9080494	10.1390046
0	80901.70	137638.19	170130.16	9.9079576	10.1387390

36 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	58778.53	72654.26	123606.80	9.7692187	9.8612610
1	58802.06	72698.71	123632.94	9.7693925	9.8615267
2	58825.58	72743.18	123659.09	9.7695662	9.8617923
3	58849.10	72787.67	123685.26	9.7697398	9.8620578
4	58872.62	72832.18	123711.48	9.7699134	9.8623233
5	58896.13	72876.71	123737.68	9.7700868	9.8625887
6	58919.64	72921.26	123763.93	9.7702601	9.8628541
7	58943.14	72965.82	123790.19	9.7704332	9.8631195
8	58966.63	73010.40	123816.47	9.7706063	9.8633848
9	58990.12	73055.01	123842.78	9.7707793	9.8636500
10	59013.61	73099.63	123869.11	9.7709522	9.8639152
11	59037.09	73144.27	123895.46	9.7711249	9.8641803
12	59060.57	73188.94	123921.83	9.7712976	9.8644454
13	59084.04	73233.62	123948.22	9.7714702	9.8647105
14	59107.50	73278.31	123974.64	9.7716426	9.8649755
15	59130.96	73323.03	124001.08	9.7718150	9.8652404
16	59154.42	73367.77	124027.54	9.7719872	9.8655053
17	59177.87	73412.53	124054.02	9.7721593	9.8657702
18	59201.32	73457.30	124080.52	9.7723314	9.8660350
19	59224.76	73502.10	124107.04	9.7725033	9.8662997
20	59248.19	73546.91	124133.59	9.7726751	9.8665644
21	59271.63	73591.74	124160.16	9.7728468	9.8668291
22	59295.05	73636.60	124186.75	9.7730185	9.8670937
23	59318.47	73681.47	124213.36	9.7731900	9.8673583
24	59341,89	73726.36	124239.99	9.7733614	9.8676228
25	59365.30	73771.27	124266.65	9.7735327	9.8678873
26	59388.71	73816.20	124293.33	9.7737039	9.868151
27	59412.11	73861.15	124320.03	9.7738749	9.8684160
28	59435.50	73906.11	124346.75	9.7740459	9.8686804
29	59458.89	73951.10	124373.49	9.7742168	9.8689446
30	59482.28	73996.11	124400.26	9.7743876	9.8692089

53 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
60	80901.70	137638.19	170130.16	9.9079576	10.1387390
59	80884.60	137554.03	170062.08	9.9078658	10.1384733
58	80867.49	137469.94	169994.07	9.9077740	10.1382077
57	80850.37	137385.91	169926.12	9.9076820	10.1379422
56	80833.25	137301.95	169858.25	9.9075901	10.1376767
55	80816.12	137218.05	169790.44	9.9074980	10.1374113
54	80798.99	137134.23	169722.71	9.9074059	10.1371459
53	80781.85	137050.47	169655.04	9.9073138	10.1368805
52	80764.70	136966.78	169587.43	9.9072216	10.1366152
51	80747.54	136883.15	169519.90	9.9071293	10.1363500
50	80730.38	136799.59	169452.44	9.9070370	10.1360848
49	80713.21	136716.10	169385.04	9.9069446	10.1358197
48	80696.03	136632.67	169317.71	9.9068522	10.1355546
47	80678.85	136549.31	169250.45	9.9067597	10.1352895
46	80661.66	136466.02	169183.26	9.9066671	10.1350245
45	80644.46	136382.79	169116.13	9.9065745	10.1347596
44	80627.26	136299.63	169049.07	9.9064819	10.1344947
43	80610.05	136216.53	168982.08	9.9063892	10.1342298
42	80592.83	136133.50	168915.16	9.9062964	10.1339650
41	80575.60	136050.54	168848.30	9.9062036	10.1337003
40	80558.37	135967.64	168781.51	9.9061107	10.1334356
39	80541.13	135884.81	168714.79	9.9060177	10.1331709
38	80523.89	135802.04	168648.14	9.9059247	10.1329063
37	80506.64	135719.34	168581.55	9.9058317	10.1326417
36	80489.38	135636.70	168515.03	9.9057386	10.1323772
35	80472.11	135554.13	168448.57	9.9056454	10.1321127
34	80454.84	135471.62	168382.18	9.9055522	10.1318483
33	80437.56	135389.18	168315.86	9.9054589	10.1315840
32	80420.28	135306.80	168249.61	9.9053656	10.1313196
31	80402.99	135224.49	168183.42	9.9052722	10.1310554
30	80385.69	135142.24	168117.30	9.9051787	10.1307911

36 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
30	59482.28	73996.11	124400.26	9.7743876	9.8692089
31	59505.66	74041.14	124427.05	9.7745583	9.8694731
32	59529.03	74086.18	124453.86	9.7747288	9.8697372
33	59552.40	74131.24	124480.69	9.7748993	9.8700013
34	59575.77	74176.33	124507.54	9.7750697	9.8702653
35	59599.13	74221.43	124534.42	9.7752399	9.8705293
36	59622.49	74266.55	124561.31	9.7754101	9.8707933
37	59645.84	74311.70	124588.23	9.7755801	9.8710572
38	59669.18	74356.86	124615.18	9.7757501	9.8713210
39	59692.52	74402.04	124642.14	9.7759199	9.8715848
40	59715.86	74447.24	124669.13	9.7760897	9.8718486
41	59739.19	74492.46	124696.14	9.7762593	9.8721123
42	59762.51	74537.70	124723.17	9.7764289	9.8723760
43	59785.83	74582.96	124750.22	9.7765983	9.8726396
44	59809.15	74628.24	124777.30	9.7767676	9.8729032
45	59832.46	74673.54	124804.40	9.7769369	9.8731668
46	59855.76	74718.86	124831.52	9.7771060	9.8734302
47	59879.06	74764.20	124858.66	9.7772750	9.8736937
48	59902.36	74809.56	124885.83	9.7774439	9.8739571
49	59925.65	74854.94	124913.02	9.7776128	9.8742204
50	59948.93	74900.33	124940.23	9.7777815	9.8744838
51	59972.21	74945.75	124967.46	9.7779501	9.8747470
52	59995.49	74991.19	124994.71	9.7781186	9.8750102
53	60018.76	75036.65	125021.99	9.7782870	9.8752734
54	60042.02	75082.12	125049.29	9.7784553	9.8755365
55	60065.28	75127.62	125076.61	9.7786235	9.8757996
56	60088.53	75173.14	125103.96	9.7787916	9.8760627
57	60111.79	75218.67	125131.33	9.7789596	9.8763257
58	60135.03	75264.23	125158.72	9.7791275	9.8765886
59	60158.27	75309.81	125186.13	9.7792953	9.8768515
60	60181.50	75355.40	125213.57	9.7794630	9.8771144

53 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	80385.69	135142.24	168117.30	9.9051787	10.1307911
29	80368.38	135060.06	168051.24	9.9050852	10.1305269
28	80351.07	134977.94	167985.25	9.9049916	10.1302628
27	80333.75	134895.89	167919.33	9.9048980	10.1299987
26	80316.42	134813.90	167853.47	9.9048043	10.1297347
25	80299.09	134731.97	167787.68	9.9047106	10.1294707
24	80281.75	134650.11	167721.95	9.9046168	10.1292067
23	80264.40	134568.32	167656.29	9.9045230	10.1289428
22	80247.05	134486.58	167590.70	9.9044291	10.1286790
21	80229.69	134404.92	167525.17	9.9043351	10.1284152
20	80212.32	134323.31	167459.70	9.9042411	10.1281514
19	80194.95	134241.77	167394.30	9.9041470	10.1278877
18	80177.56	134160.29	167328.97	9.9040529	10.1276240
17	80160.18	134078.88	167263.70	9.9039587	10.1273604
16	80142.78	133997.53	167198.50	9.9038644	10.1270968
15	80125.38	133916.24	167133.36	9.9037701	10.1268332
14	80107.97	133835.02	167068.28	9.9036757	10.1265698
13	80090.56	133753.86	167003.28	9.9035813	10.1263063
12	80073.14	133672.76	166938.33	9.9034868	10.1260429
11	80055.71	133591.72	166873.45	9.9033923	10.1257796
10	80038.27	133510.75	166808.64	9.9032977	10.1255162
9	80020.83	133429.84	166743.89	9.9032031	10.1252530
8	80003.38	133349.00	166679.20	9.9031084	10.1249898
7	79985.93	133268.22	166614.58	9.9030136	10.1247266
6	79968.47	133187.49	166550.02	9.9029188	10.1244635
5	79951.00	133106.84	166485.52	9.9028239	10.1242004
4	79933.52	133026.24	166421.09	9.9027289	10.1239373
3	79916.04	132945.71	166356.73	9.9026339	10.1236743
2	79898.55	132865.24	166292.43	9.9025389	10.1234114
1	79881.05	132784.83	166228.19	9.9024438	10.1231485
0	79863.55	132704.48	166164.01	9.9023486	10.1228856

37 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang
0	60181.50	75355.40	125213.57	9.7794630	9.8771144
1	60204.73	75401.02	125241.02	9.7796306	9.8773772
2	60227.95	75446.66	125268.50	9.7797981	9.8776400
3	60251.17	75492.32	125296.01	9.7799655	9.8779027
4	60274.39	75537.99	125323.53	9.7801328	9.8781654
5	60297.60	75583.69	125351.08	9.7803000	9.8784281
6	60320.80	75629.41	125378.65	9.7804671	9.8786907
7	60344.00	75675.14	125406.25	9.7806341	9.8789533
8	60367.19	75720.90	125433.87	9.7808010	9.8792158
9	60390.38	75766.68	125461.51	9.7809677	9.8794782
10	60413.56	75812.48	125489.17	9.7811344	9.8797407
11	60436.74	75858.29	125516.85	9.7813010	9.8800031
12	60459.91	75904.13	125544.56	9.7814675	9.8802654
13	60483.08	75949.99	125572.29	9.7816339	9.8805277
14	60506.24	75995.87	125600.05	9.7818002	9.8807990
15	60529.40	76041.77	125627.82	9.7819664	9.8810522
16	60552.55	76087.69	125655.62	9.7821324	9.8813144
17	60575.70	76133.63	125683.45	9.7822984	9.8815765
18	60598.84	76179.59	125711.29	9.7824643	9.8818386
19	60621.98	76225.57	125739.16	9.7826301	9.8821007
20	60645.11	76271.57	125767.05	9.7827958	9.8823627
21	60668.23	76317.59	125794.97	9.7829614	9.8826246
22	60691.36	76363.63	125822.91	9.7831268	9.8828866
23	60714.47	76409.69	125850.87	9.7832922	9.8831484
24	60737.58	76455.77	125878.85	9.7834575	9.8834103
25	60760.69	76501.88	125906.86	9.7836227	9.8836721
26	60783.79	76548.00	125934.89	9.7837878	9.8839338
27	60806.89	76594.14	125962.94	9.7839528	9.8841956
28	60829.98	76640.31	125991.02	9.7841177	9.8844572
29	60853.06	76686.49	126019.12	9.7842824	9.8847189
30	60876.14	76732.70	126047.24	9.7844471	9.8849805

52 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
60	79863.55	132704.48	166164.01	9.9023486	10.1228856
59	79846.04	132624.20	166099.90	9.9022534	10.1226228
58	79828.53	132543.97	166035.85	9.9021581	10.1223600
57	79811.00	132463.81	165971.87	9.9020628	10.1220973
56	79793.47	132383.71	165977.95	9.9019674	10.1218346
55	79775.94	132303.68	165844.09	9.9018719	10.1215719
54	79758.39	132223.70	165780.30	9.9017764	10.1213093
53	79740.84	132143.79	165716.57	9.9016808	10.1210467
52	79723.29	132063.93	165652.90	9.9015852	10.1207842
51	79705.72	131984.14	165589.29	9.9014895	10.1205218
50	79688.15	131904.41	165525.75	9.9013938	10.1202593
49	79670.58	131824.74	165462.27	9.9012980	10.1199969
48	79652.99	131745.13	165398.85	9.9012021	10.1197346
47	79635.40	131665.59	165335.50	9.9011062	10.1194723
46	79617.80	131586.10	165272.21	9.9010102	10.1192100
45	79600.20	131506.68	165200.98	9.9009142	10.1189478
44	79582.59	131427.31	165145.81	9.9008181	10.1186856
43	79564.97	131348.01	165082.70	9.9007219	10.1184235
42	79547.35	131268.76	165019.66	9.9006257	10.1181614
41	79529.72	131189.58	164956.68	9.9005294	10.1178993
40	79512.08	131110.46	164893.76	9.9004331	10.1176373
39	79494.44	131031.40	164830.90	9.9003367	10.1173754
38	79476.78	130952.39	164768.11	9.9002403	10.1171134
37	79459.13	130873.45	164705.37	9.9001438	10.1168516
36	79441.46	130794.57	164642.70	9.9000472	10.1165897
35	79423.79	130715.75	164580.09	9.8999506	10.1163279
34	79406.11	130636.99	164517.54	9.8998539	10.1160662
33	79388.43	130558.28	164455.06	9.8997572	10.1158044
32	79370.74	130479.64	164392.63	9.8996604	10.1155428
31	79353.04	130401.06	164330.27	9.8995636	10.1152811
30	79335.33	130322.54	164267.96	9.8994667	10.1150195

37 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	60876.14	76732.70	126047.24	9.7844471	9.8849805
31	60899.22	76778.93	126075.39	9.7846117	9.8852420
32	60922.29	76825.17	126103.56	9.7847763	9.8855035
33	60945.35	76871.44	126131.75	9.7849406	9.8857650
34	60968.41	76917.73	126159.97	9.7851049	9.8860264
35	60991.47	76964.04	126188.29	9.7852691	9.8862878
36	61014.52	77010.37	126216.46	9.7854332	9.8865492
37	61037.56	77056.72	126244.75	9.7855972	9.8868105
38	61060.60	77103.09	126273.06	9.7857611	9.8870718
39	61083.63	77149.48	126301.40	9.7859249	9.8873330
40	61106.66	77195.89	126329.75	9.7860886	9.8875942
41	61129.69	77242.33	126358.13	9.7862522	9.8878554
42	61152.70	77288.79	126386.53	9.7864157	9.8881165
43	61175.72	77335.26	126414.96	9.7865791	9.8883775
44	61198.73	77381.75	126443.41	9.7867424	9.8886386
45	61221.73	77428.27	126471.88	9.7869056	9.8888996
46	61244.73	77474.81	126500.38	9.7870687	9.8891605
47	61267.72	77521.37	126528.90	9.7872317	9.8894214
48	61290.71	77567.95	126557.45	9.7873946	9.8896823
49	61313.69	77614.55	126586.01	9.7875574	9.8899432
50	61336.66	77661.17	126614.60	9.7877202	9.8902040
51	61359.64	77707.82	126643.22	9.7878828	9.8904647
52	61382.60	77754.48	126671.86	9.7880453	9.8907254
53	61405.56	77801.17	126700.52	9.7882077	9.8909861
54	61428.52	77847.88	126729.21	9.7883701	9.8912468
55	61451.47	77894.60	126757.92	9.7885323	9.8915074
56	61474.42	77941.35	126786.65	9.7886944	9.8917679
57	61497.36	77988.12	126815.41	9.7888565	9.8920285
58	61520.29	78034.92	126844.19	9.7890184	9.8922890
59	61543.22	78081.73	126872.99	9.7891802	9.8925494
60	61566.15	78128.56	126901.82	9.7893420	9.8928098

52 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	79335.33	130322.54	164267.96	9.8994667	10.1150195
29	79317.62	130244.07	164205.72	9.8993697	10.1147580
28	79299.90	130165.67	164143.54	9.8992727	10.1144965
27	79282.18	130087.32	164081.42	9.8991756	10.1142350
26	79264.45	130009.04	164019.36	9.8990784	10.1139736
25	79246.71	129930.81	163957.36	9.8989812	10.1137122
24	79228.96	129852.65	163895.42	9.8988840	10.1134508
23	79211.21	129774.54	163833.55	9.8987867	10.1131895
22	79193.85	129696.49	163771.73	9.8986893	10.1129282
21	79175.69	129618.50	163709.97	9.8985919	10.1126670
20	79157.92	129540.57	163648.28	9.8984944	10.1124058
19	79140.14	129462.69	163586.64	9.8983968	10.1121446
18	79122.35	129384.88	163525.07	9.8982992	10.1118835
17	79104.56	129307.12	163463.55	9.8982015	10.1116225
16	79086.76	129229.43	163402.10	9.8981038	10.1113614
15	79068.96	129151.79	163340.70	9.8980060	10.1111004
14	79051.15	129074.21	163279.37	9.8979082	10.1108395
13	79033.33	128996.69	163218.09	9.8978103	10.1105786
12	79015.50	128919.22	163156.88	9.8977123	10.1103177
11	78997.67	128841.82	163095.72	9.8976143	10.1100568
10	78979.83	128764.47	163034.62	9.8975162	10.1097960
9	78961.98	128687.18	162973.59	9.8974181	10.1095353
8	78944.13	128609.95	162912.61	9.8973199	10.1092746
7	78926.27	128532.77	162851.69	9.8972216	10.1090139
6	78908.41	128455.66	162790.83	9.8971233	10.1087532
5	78890.54	128378.60	162730.03	9.8970249	10.1084926
4	78872.66	128301.60	162669.29	9.8969265	10.1082321
3	78854.77	128224.66	162608.61	9.8968280	10.1079715
2	78836.88	128147.76	162547.99	9.8967294	10.1077110
1	78818.98	128070.93	162487.43	9.8966308	10.1074506
0	78801.08	127994.16	162426.92	9.8965321	10.1071902

38 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	61566.15	78128.56	126901.82	9.7893420	9.8928098
1	61589.07	78175.42	126930.67	9.7895036	9.8930702
2	61611.98	78222.29	126959.55	9.7896652	9.8933306
3	61634.89	78269.19	126988.45	9.7898266	9.8935909
4	61658.79	78316.11	127017.37	9.7899880	9.8938511
5	61680.69	78363.05	127046.32	9.7901493	9.8941114
6	61703.59	78410.02	127075.29	9.7903104	9.8943715
7	61726.48	78457.00	127104.29	9.7904715	9.8946317
8	61749.36	78504.00	127133.31	9.7906325	9.8948918
9	61772.24	78551.03	127162.35	9.7907933	9.8951519
10	61795.11	78598.08	127191.42	9.7909541	9.8954119
11	61817.98	78645.15	127220.51	9.7911148	9.8956719
12	61840.84	78692.24	127249.63	9.7912754	9.8959319
13	61863.70	78739.35	127278.77	9.7914359	9.8961918
14	61886.55	78786.49	127307.94	9.7915963	9.8964517
15	61909.39	78833.64	127337.12	9.7917566	9.8967116
16	61932.24	78880.82	127366.34	9.7919168	9.8969714
17	61955.07	78928.02	127395.57	9.7920769	9.8972312
18	61977.90	78975.24	127424.84	9.7922369	9.8974910
19	62000.73	79022.48	127454.12	9.7923968	9.8977507
20	62023.55	79069.75	127483.43	9.7925566	9.8980104
21	62046.36	79117.03	127512.76	9.7927163	9.8982700
22	62069.17	79164.34	127542.12	9.7928760	9.8985296
23	62091.98	79211.67	127571.50	9.7930355	9.8987892
24	62114.78	79259.02	127600.91	9.7931949	9.8990487
25	62137.57	79306.40	127630.34	9.7933543	9.8993082
26	62160.36	79353.79	127659.80	9.7935135	9.8995677
27	62183.14	79401.21	127689.28	9.7936727	9.8998271
28	62205.92	79448.65	127718.78	9.7938317	9.9000865
29	62228.70	79496.11	127748.31	9.7939907	9.9003459
30	62251.46	79543.59	127777.89	9.7941496	9.9006052

51 Degrees.

Minutes.	Sines.	Tangents	Secants.	*Log. Sin.*	*Log. Tang.*
60	78801.08	127994.16	162426.92	9.8965321	10.1071902
59	78783.16	127917.45	162366.48	9.8964334	10.1069298
58	78765.24	127840.79	162306.09	9.8963346	10.1066694
57	78747.32	127764.19	162245.76	9.8962358	10.1064091
56	78729.39	127687.64	162185.49	9.8961369	10.1061489
55	78711.45	127611.16	162125.28	9.8960379	10.1058886
54	78693.50	127534.73	162065.13	9.8959389	10.1056285
53	78675.55	127458.36	162005.04	9.8958398	10.1053683
52	78657.59	127382.04	161945.00	9.8957406	10.1051082
51	78639.63	127305.78	161885.02	9.8956414	10.1048481
50	78621.65	127229.57	161825.10	9.8955422	10.1045881
49	78603.67	127153.42	161765.24	9.8954429	10.1043281
48	78585.69	127077.33	161705.44	9.8953435	10.1040681
47	78567.70	127001.30	161645.69	9.8952440	10.1038082
46	78549.70	126925.32	161586.00	9.8951445	10.1035483
45	78531.69	126849.39	161526.37	9.8950450	10.1032884
44	78513.68	126773.53	161466.80	9.8949453	10.1030286
43	78495.66	126697.72	161407.28	9.8948457	10.1027688
42	78477.64	126621.96	161347.83	9.8947459	10.1025090
41	78459.61	126546.26	161288.43	9.8946461	10,1022493
40	78441.57	126470.62	161229.08	9.8945463	10,1019896
39	78423.52	126395.03	161169.80	9.8944463	10.1017300
38	78405.47	126319.50	161110.57	9.8943464	10.1014704
37	78387.41	126244.02	161051.40	9.8942463	10.1012108
36	78369.35	126168.60	160992.28	9.8941462	10,1009513
35	78351.27	126093.23	160933.23	9.8940461	10.1006918
34	78333.20	126017.92	160874.23	9.8939458	10.1004323
33	78315.11	125942.67	160815.28	9.8938456	10.1001729
32	78297.02	125867.47	160756.40	9.8937452	10.0999135
31	78278.92	125792.32	160697.57	9.8936448	10.0996541
30	78260.82	125717.23	160638.79	9.8936444	10.0993948

38 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	62251.46	79543.59	127777.87	9.7941496	9.9006052
31	62274.23	79591.10	127807.45	9.7943083	9.9008645
32	62296.98	79638.62	127837.05	9.7944670	9.9011237
33	62319.74	79686.17	127866.67	9.7946256	9.9013830
34	62342.48	79733.74	127896.32	9.7947841	9.9016422
35	62365.22	79781.34	127926.00	9.7949425	9.9019013
36	62387.96	79828.95	127955.70	9.7951008	9.9021604
37	62410.69	79876.59	127985.43	9.7952590	9.9024195
38	62433.42	79924.25	128015.18	9.7954171	9.9026786
39	62456.14	79971.93	128044.95	9.7955751	9.9029376
40	62478.85	80019.63	128074.75	9.7957330	9.9031966
41	62501.56	80067.36	128104.57	9.7958909	9.9034555
42	62524.27	80115.11	128134.42	9.7960486	9.9037144
43	62546.96	80162.88	128164.30	9.7962062	9.9039733
44	62569.66	80210.67	128194.20	9.7963638	9.9042321
45	62592.35	80258.48	128224.12	9.7965212	9.9044910
46	62615.03	80306.32	128254.07	9.7966786	9.9047497
47	62637.71	80354.18	128284.04	9.7968359	9.9050085
48	62660.38	80402.06	128314.04	9.7969930	9.9052672
49	62683.05	80449.97	128344.06	9.7971501	9.9055259
50	62705.71	80497.90	128374.11	9.7973071	9.9057845
51	62728.37	80545.85	128404.18	9.7974640	9.9060431
52	62751.02	80593.82	128434.28	9.7976208	9.9063017
53	62773.66	80641.81	128464.40	9.7977775	9.9065603
54	62796.31	80689.83	128494.55	9.7979341	9.9068188
55	62818.94	80737.87	128524.72	9.7980906	9.9070773
56	62841.57	80785.93	128554.92	9.7982470	9.9073357
57	62864.20	80834.01	128585.14	9.7984034	9.9075941
58	62886.82	80882.12	128615.39	9.7985596	9.9078525
59	62909.43	80930.25	128645.66	9.7987158	9.9081109
60	62932.04	80978.40	128675.96	9.7988718	9.9083692

51 Degrees.

Minutes.	Sines.	Tangent.	Secants.	Log. Sin.	Log. Tang.
30	78260.82	125717.23	160638.79	9.8935444	10.0993948
29	78242.70	125642.19	160580.08	9.8934439	10.0991355
28	78224.59	125567.21	160521.42	9.8933433	10.0988763
27	78206.46	125492.29	160462.81	9.8932426	10.0986170
26	78188.33	125417.42	160404.26	9.8931419	10.0983578
25	78170.19	125342.60	160345.77	9.8930412	10.0980987
24	78152.05	125267.84	160287.34	9.8929404	10.0978396
23	78133.90	125193.13	160228.96	9.8928395	10.0975805
22	78115.74	125118.48	160170.64	9.8927385	10.0973214
21	78097.57	125043.88	160112.37	9.8926375	10.0970624
20	78079.40	124969.33	160054.16	9.8925365	10.0968034
19	78061.22	124894.84	159996.00	9.8924354	10.0965445
18	78043.04	124820.40	159937.90	9.8923342	10.0962856
17	78024.85	124746.02	159879.86	9.8922329	10.0960267
16	78006.65	124671.69	159821.87	9.8921316	10.0957679
15	77988.45	124597.42	159763.94	9.8920303	10.0955090
14	77970.24	124523.20	159706.06	9.8919289	10.0952503
13	77952.02	124449.03	159648.24	9.8918274	10.0949915
12	77933.80	124374.92	159590.47	9.8917258	10.0947328
11	77915.57	124300.86	159532.76	9.8916242	10.0944741
10	77897.33	124226.85	159475.11	9.8915226	10.0942155
9	77879.09	124152.90	159417.51	9.8914208	10.0939569
8	77860.83	124079.00	159359.96	9.8913191	10.0936983
7	77842.58	124005.15	159302.47	9.8912172	10.0934397
6	77824.31	123931.36	159245.04	9.8911153	10.0931812
5	77806.04	123857.62	159187.66	9.8910133	10.0929227
4	77787.77	123783.93	159130.33	9.8909113	10.0926643
3	77769.49	123710.30	159073.06	9.8908092	10.0924059
2	77751.20	123636.72	159015.84	9.8907071	10.0921475
1	77732.90	123563.19	158958.68	9.8906049	10.0918891
0	77714.60	123489.72	158901.57	9.8905026	10.0916308

39 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
0	62933.04	80978.40	128675.96	9.7988718	9.9083692
1	62954.64	81026.58	128706.28	9.7990278	9.9086275
2	62977.24	81074.78	128736.63	9.7991836	9.9088858
3	62999.83	81123.00	128767.00	9.7993394	9.9091440
4	63022.42	81171.24	128797.40	9.7994951	9.9094022
5	63045.00	81219.51	128827.82	9.7996507	9.9096603
6	63067.58	81267.80	128858.27	9.7998062	9.909918[illegible]
7	63090.15	81316.11	128888.75	9.7999616	9.9101766
8	63112.72	81364.44	128919.25	9.8001169	9.9104347
9	63135.28	81412.80	128949.77	9.8002721	9.9106927
10	63157.84	81461.18	128980.32	9.8004272	9.9109507
11	63180.39	81509.58	129010.90	9.8005823	9.9112087
12	63202.93	81558.01	129041.50	9.8007372	9.9114666
13	63225.47	81606.46	129072.13	9.8008921	9.9117245
14	63248.00	81654.93	129102.78	9.8010468	9.9119824
15	63270.53	81703.43	129133.46	9.8012015	9.9122403
16	63293.06	81751.95	129164.16	9.8013561	9.9124981
17	63315.57	81800.49	129194.89	9.8015106	9.9127559
18	63338.09	81849.05	129225.64	9.8016649	9.9130137
19	63360.59	81897.64	129256.42	9.8018192	9.9132714
20	63383.10	81946.25	129287.23	9.8019735	9.9135291
21	63405.59	81994.88	129318.06	9.8021276	9.9137868
22	63428.08	82043.54	129348.92	9.8022816	9.9140444
23	63450.57	82092.22	129379.80	9.8024355	9.9143020
24	63473.05	82140.93	129410.71	9.8025894	9.9145596
25	63495.53	82189.65	129441.64	9.8027431	9.9148171
26	63518.00	82238.40	129472.60	9.8028968	9.9150747
27	63540.46	82287.18	129503.59	9.8030504	9.9153322
28	63562.92	82335.97	129534.60	9.8032038	9.9155896
29	63585.37	82384.79	129565.64	9.8033572	9.9158471
30	63607.82	82433.64	129596.70	9.8035105	9.9161045

50 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	77714.60	123489.72	158901.57	9.8905026	10.0916308
59	77696.29	123416.29	158844.52	9.8904003	10.0913725
58	77677.97	123342.92	158787.52	9.8902979	10.0911142
57	77659.65	123269.61	158730.58	9.8901954	10.0908560
56	77641.32	123196.34	158673.69	9.8900929	10.0905978
55	77622.98	123123.13	158616.85	9.8899903	10.0903397
54	77604.64	123049.97	158560.07	9.8898877	10.0900815
53	77586.29	122976.87	158503.34	9.8897850	10.0898234
52	77567.94	122903.81	158446.67	9.8896822	10.0895653
51	77549.57	122830.81	158390.05	9.8895794	10.0893073
50	77531.21	122757.86	158333.48	9.8894765	10.0890493
49	77512.83	122684.96	158276.97	9.8893736	10.0887913
48	77494.45	122612.11	158220.51	9.8892706	10.0885334
47	77476.06	122539.32	158164.11	9.8891675	10.0882755
46	77457.67	122466.58	158107.76	9.8890644	10.0880176
45	77439.26	122393.89	158051.46	9.8889612	10.0877597
44	77420.86	122321.25	157995.21	9.8888580	10.0875019
43	77402.44	122248.66	157939.02	9.8887547	10.0872441
42	77384.02	122176.13	157882.89	9.8886513	10.0869863
41	77365.59	122103.64	157826.80	9.8885479	10.0867286
40	77347.16	122031.21	157770.77	9.8884444	10.0864709
39	77328.72	121958.83	157714.79	9.8883408	10.0862132
38	77310.27	121886.50	157658.87	9.8882372	10.0859556
37	77291.82	121814.22	157603.00	9.8881335	10.0856980
36	77273.36	121741.99	157547.18	9.8880298	10.0854404
35	77254.89	121669.82	157491.41	9.8879260	10.0851829
34	77236.42	121597.69	157435.70	9.8878221	10.0849253
33	77217.94	121525.62	157380.04	9.8877182	10.0846678
32	77199.45	121453.59	157324.43	9.8876142	10.0844104
31	77180.96	121381.62	157268.87	9.8875102	10.0841529
30	77162.46	121309.70	157213.37	9.8874061	10.0838955

39 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	63607.82	82433.64	129596.70	9.8035105	9.9161045
31	63630.26	82482.51	129627.79	9.8036637	9.9163618
32	63652.70	82531.40	129658.90	9.8038168	9.9166192
33	63675.13	82580.31	129690.04	9.8039699	9.9168765
34	63697.56	82629.25	129721.21	9.8041228	9.9171338
35	63719.98	82678.21	129752.40	9.8042757	9.9173911
36	63742.40	82727.19	129783.62	9.8044284	9.9176483
37	63764.81	82776.20	129814.87	9.8045811	9.9179055
38	63787.21	82825.23	129846.14	9.8047336	9.9181627
39	63809.61	82874.29	129877.44	9.8048861	9.9184198
40	63832.01	82923.37	129908.76	9.8050385	9.9186769
41	63854.40	82972.47	129940.11	9.8051908	9.9189340
42	63876.78	83021.60	129971.48	9.8053430	9.9191911
43	63899.16	83070.75	130002.88	9.8054951	9.9194481
44	63921.53	83119.92	130034.31	9.8056472	9.9197051
45	63943.90	83169.12	130065.76	9.8057991	9.9199621
46	63966.26	83218.34	130097.24	9.8059510	9.9202191
47	63988.62	83267.59	130128.75	9.8061027	9.9204760
48	64010.97	83316.86	130160.28	9.8062544	9.9207329
49	64033.32	83366.15	130191.84	9.8064060	9.9209898
50	64055.66	83415.47	130223.43	9.8065575	9.9212466
51	64077.99	83464.81	130255.04	9.8067089	9.9215034
52	64100.32	83514.18	130286.68	9.8068602	9.9217602
53	64122 64	83563.57	130318.34	9.8070114	9.9220170
54	64144.96	83612.98	130350.03	9.8071626	9.9222737
55	64167.28	83662.42	130381.75	9.8073136	9.9225304
56	64189.58	83711.88	130413.49	9.8074646	9.9227871
57	64211.89	83761.36	130445.26	9.8076154	9.9230437
58	64234.18	83810.87	130477.06	9.8077662	9.9233004
59	64256.47	83860.40	130508.88	9.8079169	9.9235570
60	64278.76	83909.96	130540.73	9.8080675	9.9238335

50 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	77162.46	121309.70	157213.37	9.8874061	10.0838955
29	77143.95	121237.83	157157.92	9.8873019	10.0836382
28	77125.44	121166.01	157102.52	9.8871977	10.0833808
27	77106.92	121094.24	157047.17	9.8870934	10.0831235
26	77088.39	121022.52	156991.88	9.8869890	10.0838662
25	77069.86	120950.85	156936.64	9.8868846	10.0826089
24	77051.32	120879.23	156881.45	9.8867801	10.0823517
23	77032.78	120807.67	156826.31	9.8866756	10.0820945
22	77014.23	120736.15	156771.23	9.8865710	10.0818373
21	76995.67	120664.68	156716.19	9.8864663	10.0815802
20	76977.10	120593.27	156661.21	9.8863616	10.0813231
19	76958.53	120521.90	156606.28	9.8862568	10.0810660
18	76939.96	120450.58	156551.41	9.8861519	10.0808089
17	76921.37	120379.31	156496.58	9.8860470	10.0805519
16	76902.78	120308.10	156441.81	9.8859420	10.0802949
15	76884.18	120236.93	156387.08	9.8858370	10.0800379
14	76865.58	120165.81	156332.41	9.8857319	10.0797809
13	76846.97	120094.75	156277.79	9.8856267	10.0795240
12	76828.35	120023.73	156223.22	9.8855215	10.0792671
11	76809.73	119952.76	156168.70	9.8854162	10.0790102
10	76791.10	119881.84	156114.24	9.8853109	10.0787534
9	76772.46	119810.97	156059.82	9.8852055	10.0784966
8	76753.82	119740.15	156005.46	9.8851000	10.0782398
7	76735.17	119669.38	155951.15	9.8849945	10.0779830
6	76716.51	119598.66	155896.89	9.8848889	10.0777263
5	76697.85	119527.99	155842.67	9.8847832	10.0774696
4	76679.18	119457.36	155788.51	9.8846775	10.0772129
3	76660.51	119386.79	155734.41	9.8845717	10.0769563
2	76641.83	119316.26	155680.35	9.8844659	10.0766996
1	76623.14	119245.79	155626.34	9.8843599	10.0764430
0	76604.44	119175.36	155572.38	9.8842540	10.0761865

40 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	64278.76	83909.96	130540.73	9.8080675	9.9238135
1	64301.04	83959.54	130572.61	9.8082180	9.9240701
2	64323.32	84009.15	130604.71	9.8083684	9.9243266
3	64345.59	84058.78	130636.44	9.8085188	9.9245831
4	64367.85	84108.44	130668.39	9.8086690	9.9248396
5	64390.11	84158.12	130700.37	9.8088192	9.9250960
6	64412.36	84207.82	130732.38	9.8089692	9.9253524
7	64434.61	84257.55	130764.42	9.8091192	9.9256088
8	64456.85	84307.30	130796.49	9.8092691	9.9258652
9	64479.09	84357.08	130828.58	9.8094189	9.9261215
10	64501.32	84406.88	130860.70	9.8095686	9.9263778
11	64523.55	84456.70	130892.84	9.8097182	9.9266341
12	64545.77	84506.55	130925.01	9.8098678	9.9268904
13	64567.98	84556.43	130957.21	9.8100172	9.9271466
14	64590.19	84606.33	130989.43	9.8101666	9.9274028
15	64612.40	84656.25	131021.68	9.8103159	9.9276590
16	64634.60	84706.20	131053.96	9.8104650	9.9279152
17	64656.79	84756.17	131086.26	9.8106141	9.9281713
18	64678.98	84806.17	131118.59	9.8107631	9.9284274
19	64701.16	84856.19	131150.95	9.8109121	9.9286835
20	64723.34	84906.24	131183.34	9.8110609	9.9289396
21	64745.51	84956.31	131215.75	9.8112096	9.9291956
22	64767.67	85006.40	131248.19	9.8113583	9.9294516
23	64789.83	85056.52	131280.66	9.8115069	9.9297076
24	64811.99	85106.67	131313.16	9.8116554	9.9299636
25	64834.14	85156.84	131345.68	9.8118038	9.9302195
26	64856.28	85207.04	131378.23	9.8119521	9.9304755
27	64878.42	85257.26	131410.81	9.8121003	9.9307314
28	64900.55	85307.50	131443.41	9.8122484	9.9309872
29	64922.68	85357.77	131476.04	9.8123965	9.9312431
30	64944.80	85408.07	131508.70	9.8125444	9.9314989

49 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
60	76604.44	119175.36	155572.38	9.8842540	10.0761865
59	76585.74	119104.98	155518.48	9.8841479	10.0759299
58	76567.04	119034.65	155464.62	9.8840418	10.0756734
57	76548.32	118964.37	155410.81	9.8439357	10.0754169
56	76529.60	118894.14	155357.06	9.8838294	10.0751604
55	76510.87	118823.95	155303.35	9.8837232	10.0749040
54	76492.14	118753.82	155249.70	9.8836168	10.0446476
53	76473.40	118683.73	155196.09	9.8835104	10.0743912
52	76454.65	118613.69	155142.54	9.8834039	10.0741348
51	76435.90	118543.70	155089.04	9.8832974	10.0738785
50	76417.14	118473.76	155035.58	9.8831908	10.0736222
49	76398.37	118403.87	154982.18	9.8830841	10.0733659
48	76379.60	118334.02	154928.82	9.8829774	10.0731096
47	76360.82	118264.22	154875.52	9.8828706	10.0728534
46	76342.04	118194.47	154822.26	9.8827638	10.0725972
45	76323.25	118124.77	154769.06	9.8826568	10.0723410
44	76304.45	118055.12	154715.90	9.8825499	10.0720848
43	76285.64	117985.51	154662.80	9.882442[illegible]	10.0718287
42	76266.83	117915.95	154609.74	9.8823357	10.0715726
41	76248.02	117846.44	154556.73	9.8822285	10.0713165
40	76229.19	117776.98	154503.78	9.8821213	10.0710604
39	76210.36	117707.56	154450.87	9.8820140	10.0708044
38	76191.52	117638.20	154398.01	9.8819067	10.0705484
37	76172.68	117568.88	154345.20	9.8817992	10.0702924
36	76153.83	117499.60	154292.44	9.8816918	10.0700364
35	76134.97	117430.38	154239.73	9.8815842	10.0697805
34	76116.11	117361.20	154187.06	9.8814766	10.0695245
33	76097.24	117292.07	154134.45	9.8813689	10.0692686
32	76078.37	117222.98	154081.89	9.8812612	10.0690128
31	76059.49	117153.95	154029.37	9.8811534	10.0687569
30	76040.60	117084.96	153976.90	9.8810455	10.0685011

40 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
30	64944.80	85408.07	131508.70	9.8125444	9.9314989
31	64966.92	85458.39	131541.39	9.8126923	9.9317547
32	64989.03	85508.73	131574.10	9.8128401	9.9320105
33	65011.14	85559.10	131606.84	9.8129878	9.9322662
34	65033.24	85609.50	131639.61	9.8131354	9.9325220
35	65055.33	85659.92	131672.41	9.8132829	9.9327777
36	65077.42	85710.37	131705.23	9.8134303	9.9330334
37	65099.50	85760.84	131738.08	9.8135777	9.9332890
38	65121.58	85811.33	131770.96	9.8137250	9.9335446
39	65143.66	85861.85	131803.86	9.8138721	9.9338003
40	65165.72	85912.40	131836.79	9.8140192	9.9340559
41	65187.78	85962.97	131869.75	9.8141662	9.9343114
42	65209.84	86013.57	131902.74	9.8143131	9.9345670
43	65231.89	86064.19	131935.76	9.8144600	9.9348225
44	65253.94	86114.84	131968.81	9.8146067	9.9350780
45	65275.98	86165.51	132001.88	9.8147534	9.9353335
46	65298.01	86216.21	132034.98	9.8148999	9.9355889
47	65320.04	86266.93	132068.11	9.8150464	9.9358444
48	65342.06	86317.68	132101.26	9.8151928	9.9360998
49	65364.08	86368.46	132134.44	9.8153391	9.9363552
50	65386.09	86419.26	132167.65	9.8154854	9.9366105
51	65408.10	86470.09	132200.89	9.8156315	9.9368659
52	65430.10	86520.94	132234.16	9.8157776	9.9371212
53	65452.09	86571.81	132267.45	9.8159235	9.9373765
54	65474.08	86622.71	132300.77	9.8160694	9.9376318
55	65496.07	86673.64	132334.12	9.8162152	9.9378871
56	65518.04	86724.60	132367.50	9.8163609	9.9381423
57	65540.02	86775.58	132400.91	9.8165066	9.9383975
58	65561.98	86826.59	132434.35	9.8166521	9.9386527
59	65583.95	86877.62	132467.81	9.8167975	9.9389079
60	65605.90	86928.68	132501.30	9.8169429	9.9391631

49 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	76040.60	117084.96	153976.90	9.8810455	10.0685011
29	76021.70	117016.01	153924.49	9.8809376	10.0682458
28	76002.80	116947.12	153872.12	9.8808296	10.0679895
27	75983.89	116878.27	153819.80	9.8807215	10.0677338
26	75964.98	116809.47	153767.52	9.8806134	10.0674780
25	75946.06	116740.71	153715.30	9.8805052	10.0672223
24	75927.13	116672.00	153663.12	9.8803970	10.0669666
23	75908.20	116603.34	153611.00	9.8802887	10.0667110
22	75889.26	116534.72	153558.92	9.8801803	10.0664554
21	75870.31	116466.15	153506.89	9.8800719	10.0661997
20	75851.36	116397.63	153454.91	9.8799634	10.0659441
19	75832.40	116329.16	153402.97	9.8798548	10.0656886
18	75813.43	116260.73	153351.09	9.8797462	10.0654330
17	75794.46	116192.34	153299.25	9.8796375	10.0651775
16	75775.48	116124.00	153247.46	9.8795287	10.0649220
15	75756.50	116055.71	153195.72	9.8794199	10.0646665
14	75737.51	115987.47	153144.03	9.8793110	10.0644111
13	75718.51	115919.27	153092.38	9.8792021	10.0641556
12	75699.51	115851.11	153040.78	9.8790930	10.0639002
11	75680.49	115783.01	152989.23	9.8789840	10.0636448
10	75661.48	115714.95	152937.73	9.8788748	10.0633895
9	75642.45	115646.93	152886.27	9.8787656	10.0631341
8	75623.43	115578.96	152834.87	9.8786563	10.0628788
7	75604.39	115511.04	152783.51	9.8785470	10.0626235
6	75585.35	115443.16	152732.19	9.8784376	10.0623682
5	75566.30	115375.32	152680.93	9.8783281	10.0621129
4	75547.24	115307.54	152629.71	9.8782186	10.0618577
3	75528.18	115239.79	152578.54	9.8781090	10.0616025
2	75509.11	115172.10	152527.41	9.8779994	10.0613473
1	75490.04	115104.45	152476.34	9.8778896	10.0610921
0	75470.96	115036.84	152425.31	9.8777799	10.0608369

41 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang
0	65605.90	86928.68	132501.30	9.8169429	9.9391631
1	65627.85	86979.76	132534.82	9.8170882	9.9394182
2	65649.80	87030.87	132568.37	9.8172334	9.9396733
3	65671.74	87082.00	132601.94	9.8173785	9.9399284
4	65693.67	87133.16	132635.54	9.8175235	9.9401835
5	65715.60	87184.35	132669.18	9.8176685	9.9404385
6	65737.52	87235.56	132702.84	9.8178133	9.9406936
7	65759.44	87286.80	132736.53	9.8179581	9.9409486
8	65781.35	87338.06	132770.25	9.8181028	9.9412036
9	65803.26	87389.35	132803.99	9.8182474	9.9414585
10	65825.16	87440.67	132837.76	9.8183919	9.9417135
11	65847.06	87492.01	132871.56	9.8185364	9.9419684
12	65868.95	87543.38	132905.39	9.8186807	9.9422233
13	65890.83	87594.78	132939.25	9.8188250	9.9424782
14	65912.71	87646.20	132973.14	9.8189692	9.9427331
15	65934.58	87697.65	133007.06	9.8191133	9.9429879
16	65956.45	87749.12	133041.00	9.8192573	9.9432428
17	65978.31	87800.62	133074.97	9.8194012	9.9434976
18	66000.17	87852.15	133108.97	9.8195450	9.9437524
19	66022.02	87903.70	133143.00	9.8196888	9.9440072
20	66043.86	87955.28	133177.02	9.8198325	9.9442619
21	66065.70	88006.89	133211.15	9.8199761	9.9445166
22	66087.54	88058.52	133245.27	9.8201196	9.9447714
23	66109.36	88110.18	133279.42	9.8202630	9.9450261
24	66131.19	88161.86	133313.59	9.8204063	9.9452807
25	66153.00	88213.57	133347.79	9.8205496	9.9455354
26	66174.81	88265.31	133382.02	9.8206927	9.9457900
27	66196.62	88317.07	133416.28	9.8208358	9.9460447
28	66218.42	88368.86	133450.57	9.8209788	9.9462993
29	66240.22	88420.68	133484.89	9.8211217	9.9465539
30	66262.00	88472.53	133519.24	9.8242646	9.9468084

48 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
60	75470.96	115036.84	152425.31	9.8777799	10.0608369
59	75451.87	114969.28	152374.33	9.8776700	10.0605818
58	75432.78	114901.76	152323.39	9.8775601	10.0603267
57	75413.68	114834.29	152272.50	9.8774501	10.0600716
56	75394.57	114766.87	152221.66	9.8773401	10.0598165
55	75375.46	111699.49	152170.87	9.8772300	10.0595615
54	75356.34	114632.15	152120.12	9.8771198	10.0593064
53	75337.21	114564.86	152069.42	9.8770096	10.0590514
52	75318.08	114497.62	152018.76	9.8768993	10.0587964
51	75298.94	114430.41	151968.15	9.8767889	10.0585415
50	75279.80	114363.26	151917.59	9.8766785	10.0582865
49	75260.65	114296.15	151867.08	9.8765680	10.0580316
48	75241.49	114229.08	151816.61	9.8764574	10.0577767
47	75222.33	114162.06	151766.19	9.8763468	10.0575218
46	75203.16	114095.08	151715.81	9.8762361	10.0572669
45	75183.98	114028.15	151665.48	9.8761253	10.0570121
44	75164.80	113961.26	151615.20	9.8760145	10.0567572
43	75145.61	113894.41	151564.96	9.8759036	10.0565024
42	75126.41	113827.61	151514.77	9.8757927	10.0562476
41	75107.21	113760.85	151464.62	9.8756816	10.0559928
40	75088.00	113694.14	151414.52	9.8755706	10.0557381
39	75068.79	113627.47	151364.47	9.8754594	10.0554834
38	75049.57	113560.85	151314.46	9.8753482	10.0552286
37	75030.34	113494.27	151264.50	9.8752369	10.0549739
36	75011.11	113427.73	151214.59	9.8751256	10.0547193
35	74991.87	113361.24	151164.72	9.8750142	10.0544646
34	74972.62	113294.79	151114.89	9.8749027	10.0542100
33	74953.37	113228.39	151065.11	9.8747912	10.0539553
32	74934.11	113162.03	151015.38	9.8746795	10.0537007
31	74914.84	113095.71	150965.69	9.8745679	10.0534461
30	74895.57	113029.44	150916.05	9.8744561	10.0531916

41 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
30	66262.00	88472.53	133519.24	9.8212646	9.9468084
31	66283.79	88524.40	133553.62	9.8214073	9.9470630
32	66305.57	88576.30	133588.03	9.8215500	9.9473175
33	66327.34	88628.22	133622.46	9.8216926	9.9475720
34	66349.10	88680.17	133656.92	9.8218351	9.9478265
35	66370.87	88732.15	133691.41	9.8219775	9.9480810
36	66392.62	88784.16	133725.94	9.8221198	9.9483355
37	66414.37	88836.20	133760.49	9.8222621	9.9485899
38	66436.15	88888.26	133795.07	9.8224042	9.9488443
39	66457.85	88940.34	133829.68	9.8225463	9.9490987
40	66479.59	88992.45	133864.32	9.8226883	9.9493531
41	66501.31	89044.59	133898.99	9.8228302	9.9496075
42	66523.04	89096.75	133933.69	9.8229721	9.9498619
43	66544.75	89148.94	133968.42	9.8231138	9.9501162
44	66566.46	89201.16	134003.17	9.8232555	9.9503705
45	66588.17	89253.41	134037.95	9.8233971	9.9506248
46	66609.87	89305.69	134072.76	9.8235386	9.9508791
47	66631.56	89357.99	134107.61	9.8236800	9.9511334
48	66653.25	89410.32	134142.48	9.8238213	9.9513876
49	66674.93	89462.68	134177.38	9.8239626	9.9516419
50	66696.61	89515.06	134212.32	9.8241037	9.9518961
51	66718.28	89567.47	134247.28	9.8242448	9.9521503
52	66739.94	89619.91	134282.27	9.8243858	9.9524045
53	66761.60	89672.38	134317.29	9.8245267	9.9526587
54	66783.26	89724.87	134352.34	9.8246676	9.9529128
55	66804.90	89777.39	134387.42	9.8248083	9.9531670
56	66826.55	89829.94	134422.53	9.8249490	9.9534211
57	66848.18	89882.52	134457.67	9.8250896	9.9536752
58	66869.81	89935.12	134492.84	9.8252301	9.9539293
59	66891.44	89987.75	134528.04	9.8253705	9.9541834
60	66913.06	89040.41	134563.27	9.8255109	9.9544374

48 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
30	74895.57	113029.44	150916.05	9.8744561	10.0531916
29	74876.29	112963.21	150866.45	9.8743443	10.0529370
28	74857.01	112897.02	150816.90	9.8742325	10.0526825
27	74837.72	112830.88	150767.39	9.8741205	10.0524280
26	74818.42	112764.78	150717.93	9.8740085	10.0521735
25	74799.12	112698.72	150668.52	9.8738965	10.0519190
24	74779.81	112632.71	150619.15	9.8737844	10.0516645
23	74760.49	112566.74	150569.82	9.8736722	10.0514101
22	74741.17	112500.81	150520.54	9.8735599	10.0511557
21	74721.84	112434.93	150471.31	9.8734476	10.0509013
20	74702.51	112369.09	150422.11	9.8733352	10.0506469
19	74683.17	112303.29	150372.97	9.8732227	10.0503925
18	74663.82	112237.54	150323.87	9.8731102	10.0501381
17	74644.46	112171.83	150274.81	9.8729976	10.0498838
16	74625.10	112106.16	150225.80	9.8728849	10.0496295
15	74605.74	112040.53	150176.83	9.8727722	10.0493752
14	74586.36	111974.95	150127.91	9.8726594	10.0491209
13	74566.99	111909.41	150079.03	9.8725466	10.0488666
12	74547.60	111843.91	150030.20	9 8724337	10.0486124
11	74528.21	111778.46	149981.41	9.8723207	10.0483581
10	74508.81	111713.05	149932.67	9.8722076	10.0481039
9	74489.41	111647.68	149883.97	9.8720945	10.0478497
8	74469.99	111582.35	149835.31	9.8719813	10.0475955
7	74450.58	111517.06	149786.70	9.8718681	10.0473413
6	74431.15	111451.82	149738.13	9.8717548	10.0470872
5	74411.72	111386.62	149689.61	9.8716414	10.0468330
4	74392.29	111321.46	149641.13	9.8715279	10.0465789
3	74372.85	111256.35	149592.70	9.8714144	10.0463248
2	74353.40	111191.27	149544.30	9.8713008	10.0460707
1	74333.94	111126.24	149495.96	9.8711872	10.0458166
0	74314.48	111061.25	149447.65	9.8710735	10.0455626

42 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	66913.06	90040.41	134563.27	9.8255109	9.9544374
1	66934.67	90093.09	134598.53	9.8256512	9.9546915
2	66956.28	90145.80	134633.82	9.8257913	9.9549455
3	66977.89	90198.54	134669.14	9.8259314	9.9551995
4	66999.48	90251.31	134704.49	9.8260715	9.9554535
5	67021.08	90304.11	134739.87	9.8262114	9.9557075
6	67042.66	90356.94	134775.28	9.8263512	9.9559615
7	67064.24	90409.79	134810.72	9.8264910	9.9562154
8	67085.82	90462.67	134846.19	9.8266307	9.9564694
9	67107.39	90515.58	134881.69	9.8267703	9.9567233
10	67128.95	90568.51	134917.21	9.8269098	9.9569772
11	67150.51	90621.47	134952.77	9.8270493	9.9572311
12	67172.06	90674.46	134988.36	9.8271887	9.9574850
13	67193.61	90727.48	135023.98	9.8273279	9.9577389
14	67215.15	90780.53	135059.63	9.8274671	9.9579927
15	67236.68	90833.60	135095.31	9.8276063	9.9582465
16	67258.21	90886.71	135131.02	9.8277453	9.9585004
17	67279.73	90939.84	135166.73	9.8278843	9.9587542
18	67301.25	90993.00	135202.54	9.8280231	9.9590080
19	67322.76	91046.19	135238.34	9.8281619	9.9592618
20	67344.27	91099.41	135274.17	9.8283006	9.9595155
21	67365.77	91152.65	135310.03	9.8284393	9.9597693
22	67387.27	91205.92	135345.93	9.8285778	9.9600230
23	67408.76	91259.22	135381.86	9.8287163	9.9602767
24	67430.24	91312.55	135417.81	9.8288547	9.9605305
25	67451.72	91365.91	135453.79	9.8289930	9.9607842
26	67473.19	91419.29	135489.80	9.8291312	9.9610378
27	67494.66	91472.70	135525.85	9.8292694	9.9612915
28	67516.12	91526.15	135561.93	9.8294075	9.9615452
29	67537.57	91579.62	135598.03	9.8295454	9.9617988
30	67559.02	91633.12	135634.17	9.8296833	9.9620525

47 Degrees.

Minutes.	Sines.	Tangents	Secants.	Log. Sin.	Log. Tang.
60	74314.48	111061.25	149447.65	9.8710735	10.0455626
59	74295.01	110996.30	149399.40	9.8709597	10.0453085
58	74275.54	110931.40	149351.18	9.8708458	10.0450545
57	74256.06	110866.53	149303.01	9.8707319	10.0448005
56	74236.57	110801.71	149254.88	9.8706179	10.0445465
55	74217.08	110736.93	149206.80	9.8705039	10.0442925
54	74197.58	110672.19	149158.75	9.8703898	10.0440385
53	74178.08	110607.50	149110.76	9.8702756	10.0437846
52	74158.57	110542.84	149062.80	9.8701613	10.0435306
51	74139.05	110478.23	149014.89	9.8700470	10.0432767
50	74119.53	110413.65	148967.03	9.8699326	10.0430228
49	74100.00	110349.12	148919.20	9.8698182	10.0427689
48	74080.46	110284.63	148871.42	9.8697037	10.0425150
47	74060.92	110220.19	148823.69	9.8695891	10.0422611
46	74041.37	110155.78	148775.99	9.8694744	10.0420073
45	74021.81	110091.41	148728.34	9.8693597	10.0417535
44	74002.25	110027.09	148680.73	9.8692449	10.0414996
43	73982.68	109962.81	148633.17	9.8691301	10.0412458
42	73963.11	109898.56	148585.65	9.8690152	10.0409920
41	73943.53	109834.36	148538.17	9.8689002	10.0407382
40	73923.94	109770.20	148490.73	9.8687851	10.0404845
39	73904.35	109706.08	148443.34	9.8686700	10.0402307
38	73884.75	109642.01	148395.99	9.8685548	10.0399770
37	73865.15	109577.97	148348.68	9.8684396	10.0397233
36	73845.53	109513.97	148301.42	9.8683242	10.0394695
35	73825.92	109450.02	148254.20	9.8682088	10.0392158
34	73806.29	109386.10	148207.02	9.8680934	10.0389622
33	73786.66	109322.23	148159.88	9.8679779	10.0387085
32	73767.03	109258.40	148112.78	9.8678623	10.0384548
31	73747.38	109194.60	148065.73	9.8677466	10.0382012
30	73727.73	109130.85	148018.72	9.8676309	10.0379475

42 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	67559.02	91633.12	135634.17	9.8296833	9.9620525
31	67580.46	91686.65	135670.34	9.8298212	9.9623061
32	67601.90	91740.20	135706.54	9.8299589	9.9625597
33	67623.33	91793.79	135742.77	9.8300966	9.9628133
34	67644.76	91847.40	135779.03	9.8302342	9.9630669
35	67666.18	91901.04	135815.32	9.8303717	9.9633204
36	67687.60	91954.71	135851.64	9.8305091	9.9635740
37	67709.01	92008.41	135888.00	9.8306464	9.9638275
38	67730.41	92062.14	135924.38	9.8307837	9.9640811
39	67751.81	92115.90	135960.80	9.8309209	9.9643346
40	67773.20	92169.68	135997.25	9.8310580	9.9645881
41	67794.59	92223.50	136033.72	9.8311950	9.9648416
42	67815.97	92277.34	136070.23	9.8313320	9.9650951
43	67837.34	92331.22	136106.77	9.8314688	9.9653486
44	67858.71	92385.12	136143.34	9.8316056	9.9656020
45	67880.07	92439.05	136179.95	9.8317423	9.9658555
46	67901.43	92493.01	136216.58	9.8318789	9.9661089
47	67922.78	92547.00	136253.24	9.8320155	9.9663623
48	67944.13	92601.01	136289.94	9.8321519	9.9666157
49	67965.47	92655.06	136326.67	9.8322883	9.9668692
50	67986.81	92709.14	136363.43	9.8324246	9.9671225
51	68008.13	92763.24	136400.22	9.8325609	9.9673759
52	68029.49	92817.38	136437.04	9.8326970	9.9676293
53	68050.78	92871.54	136473.89	9.8328331	9.9678827
54	68072.09	92925.73	136510.78	9.8329691	9.9681360
55	68093.39	92979.96	136547.70	9.8331050	9.9683893
56	68114.69	93034.21	136584.64	9.8332408	9.9686427
57	68135.99	93088.49	136621.62	9.8333766	9.9688960
58	68157.28	93142.80	136658.63	9.8335122	9.9691493
59	68178.56	93197.14	136695.67	9.8336478	9.9694026
60	68199.84	93251.51	136732.75	9.8337833	9.9696559

47 Degrees.

Minutes.	Sines.	Tangent.	Secants.	*Log. Sin.*	*Log. Tang.*
30	73727.73	109130.85	148018.72	9.8676309	10.0379475
29	73708.08	109067.14	147971.76	9.8675151	10.0376939
28	73688.42	109003.47	147924.83	9.8673992	10.0374403
27	73668.75	108939.83	147877.95	9.8672833	10.0371867
26	73646.08	108876.24	147831.11	9.8671673	10.0369331
25	73629.39	108812.69	147784.31	9.8670512	10.0366796
24	73609.71	108749.18	147737.55	9.8669351	10.0364260
23	73590.02	108685.71	147690.84	9.8668189	10.0361725
22	73570.32	108622.28	147644.17	9.8667026	10.0359189
21	73550.61	108558.89	147597.54	9.8665863	10.0356654
20	73530.90	108495.54	147550.95	9.8664699	10.0354119
19	73511.18	108432.23	147504.40	9.8663534	10.0351584
18	73491.46	108368.96	147457.90	9.8662369	10.0349049
17	73471.73	108305.73	147411.44	9.8661203	10.0346514
16	73451.99	108242.54	147365.01	9.8660036	10.0343980
15	73432.25	108179.39	147318.64	9.8658868	10.0341445
14	73412.50	108116.28	147272.30	9.8657700	10.0338911
13	73392.75	108053.21	147226.00	9.8656531	10.0336377
12	73372.99	107990.18	147179.75	9.8655362	10.0333843
11	73353.22	107927.18	147133.53	9.8654192	10.0331308
10	73333.45	107864.23	147087.36	9.8653021	10.0328775
9	73313.67	107801.32	147041.23	9.8651849	10.0326241
8	73293.88	107738.44	146995.14	9.8650677	10.0323707
7	73274.09	107675.61	146949.10	9.8649504	10.0321173
6	73254.29	107612.82	146903.09	9.8648331	10.0318640
5	73234.49	107550.06	146857.13	9.8647156	10.0316107
4	73214.67	107487.34	146811.20	9.8645981	10.0313573
3	73194.86	107424.67	146765.32	9.8644806	10.0311040
2	73175.03	107362.03	146719.48	9.8643629	10.0308507
1	73155.21	107299.43	146673.68	9.8642452	10.0305974
0	73135.37	107236.87	146627.92	9.8641275	10.0303441

43 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	68199.84	93251.51	136732.75	9.8337833	9.9696559
1	68221.11	93305.91	136769.85	9.8339188	9.9699091
2	68242.37	93360.34	136806.99	9.8340541	9.9701624
3	68263.63	93414.79	136844.16	9.8341894	9.9704157
4	68284.89	93469.28	136881.36	9.8343246	9.9706689
5	68306.13	93523.80	136918.59	9.8344597	9.9709221
6	68327.38	93578.34	136955.86	9.8345948	9.9711754
7	68348.61	93632.92	136993.15	9.8347297	9.9714286
8	68369.84	93687.53	137030.48	9.8348646	9.9716818
9	68391.07	93742.16	137067.84	9.8349994	9.9719350
10	68412.29	93796.83	137105.23	9.8351341	9.9721882
11	68433.50	93851.52	137142.66	9.8352688	9.9724413
12	68454.71	93906.25	137180.11	9.8354033	9.9726945
13	68475.91	93961.01	137217.60	9.8355378	9.9729477
14	68497.11	94015.79	137255.12	9.8356722	9.9732008
15	68518.30	94070.61	137292.68	9.8358066	9.9734539
16	68539.48	94125.45	137330.26	9.8359408	9.9737071
17	68560.66	94180.33	137367.88	9.8360750	9.9739602
18	68581.84	94235.23	137405.53	9.8362091	9.9742133
19	68603.00	94290.17	137443.21	9.8363431	9.9744664
20	68624.16	94345.13	137480.92	9.8364771	9.9747195
21	68645.32	94400.13	137518.67	9.8366109	9.9749726
22	68666.47	94455.16	137556.45	9.8367447	9.9752257
23	68687.61	94510.21	137594.26	9.8368784	9.9754787
24	68708.75	94565.30	137632.10	9.8370121	9.9757318
25	68729.88	94620.42	137669.98	9.8371456	9.9759849
26	68751.01	94675.56	137707.89	9.8372791	9.9762379
27	68772.13	94730.74	137745.83	9.8374125	9.9764909
28	68793.25	94785.95	137783.80	9.8375458	9.9767440
29	68814.35	94841.19	137821.81	9.8376790	9.9769970
30	68835.46	94896.46	137859.85	9.8378122	9.9772500

46 Degrees.

Minutes.	Sines.	Tangents.	Secants.	*Log. Sin.*	*Log. Tang.*
60	73135.37	107236.87	146627.92	9.8641275	10.0303441
59	73115.53	107174.35	146582.20	9.8640096	10.0300909
58	73095.68	107111.87	146536.52	9.8638917	10.0298376
57	73075.83	107049.43	146490.88	9.8637737	10.0295843
56	73055.97	106987.02	146445.29	9.8636557	10.0293311
55	73036.10	106924.66	146399.73	9.8635376	10.0290779
54	73016.23	106862.33	146354.22	9.8634194	10.0288246
53	72996.35	106800.04	146308.75	9.8633011	10.0285714
52	72976.46	106737.79	146263.31	9.8631828	10.0283182
51	72956.57	106675.58	146217.92	9.8630644	10.0280650
50	72936.68	106613.41	146172.57	9.8629460	10.0278118
49	72916.77	106551.28	146127.26	9.8628274	10.0275587
48	72896.86	106489.18	146081.98	9.8627088	10.0273055
47	72876.95	106427.13	146036.75	9.8625902	10.0270523
46	72857.02	106365.11	145991.56	9.8624714	10.0267992
45	72837.10	106303.13	145946.41	9.8623526	10.0265461
44	72817.16	106241.19	145901.30	9.8622338	10.0262929
43	72797.22	106179.29	145856.23	9.8621148	10.0260398
42	72777.28	106117.42	145811.20	9.8619958	10.0257867
41	72757.32	106055.60	145766.21	9.8618767	10.0255336
40	72737.36	105993.81	145721.27	9.8617576	10.0252805
39	72717.40	105932.06	145676.36	9.8616383	10.0250274
38	72697.43	105870.34	145631.49	9.8615190	10.0247743
37	72677.45	105808.67	145586.66	9.8613997	10.0245213
36	72657.47	105747.03	145541.87	9.8612803	10.0242682
35	72637.48	105685.44	145497.12	9.8611608	10.0240151
34	72617.48	105623.88	145452.41	9.8610412	10.0237621
33	72597.48	105562.35	145407.74	9.8609215	10.0235091
32	72577.47	105500.87	145363.11	9.8608018	10.0232560
31	72557.46	105439.42	145318.52	9.8606821	10.0230030
30	72537.44	105378.01	145273.97	9.8605622	10.0227500

43 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	68835.41	94896.46	137859.85	9.8378122	9.9772500
31	68856.55	94951.76	137897.92	9.8379453	9.9775030
32	68877.65	95007.09	137936.02	9.8380783	9.9777560
33	68898.73	95062.45	137974.16	9.8382112	9.9780090
34	68919.81	95117.84	138012.33	9.8383441	9.9782620
35	68940.89	95173.26	138050.53	9.8384769	9.9785149
36	68961.95	95228.71	138088.77	9.8386096	9.9787679
37	68983.02	95284.20	138127.04	9.8387422	9.9790209
38	69004.07	95339.71	138165.34	9.8388747	9.9792738
39	69025.12	95395.26	138203.67	9.8390072	9.9795268
40	69046.17	95450.83	138242.04	9.8391396	9.9797797
41	69067.21	95506.44	138280.44	9.8392719	9.9800326
42	69088.24	95562.08	138318.87	9.8394041	9.9802856
43	69109.27	95617.74	138357.34	9.8395363	9.9805385
44	69130.29	95673.44	138395.84	9.8396684	9.9807914
45	69151.31	95729.17	138434.37	9.8398004	9.9810443
46	69172.32	95784.94	138472.94	9.8399323	9.9812972
47	69193.32	95840.73	138511.54	9.8400642	9.9815501
48	69214.32	95896.5[illegible]	138550.17	9.8401959	9.9818030
49	69235.31	95952.41	138588.83	9.8403276	9.9820559
50	69256.30	96008.29	138627.53	9.8404593	9.9823087
51	69277.28	96064.21	138666.26	9.8405908	9.9825616
52	69298.25	96120.16	138705.03	9.8407223	9.9828145
53	69319.22	96176.14	138743.83	9.8408537	9.9830673
54	69340.18	96232.15	138782.66	9.8409850	9.9833202
55	69361.14	96288.19	138821.53	9.8411162	9.9836730
56	69382.09	96344.27	138860.42	9.8412474	9.9838259
57	69403.04	96400.37	138899.36	9.8413785	9.9840787
58	69423.98	96456.51	138938.32	9.8415095	9.9843315
59	69444.91	96512.68	138977.32	9.8416404	9.9845844
60	69465.84	96568.88	139016.36	9.8417713	9.9848372

46 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	72537.44	105378.01	145273.97	9.8605622	10.0227500
29	72517.41	105316.64	145229.46	9.8604423	10.0224970
28	72497.38	105255.31	145184.98	9.8603223	10.0222440
27	72477.34	105194.01	145140.55	9.8602022	10.0219910
26	72457.29	105132.75	145096.16	9.8600821	10.0217380
25	72437.24	105071.53	145051.81	9.8599619	10.0214851
24	72417.18	105010.34	145007.49	9.8598416	10.0212321
23	72397.12	104949.20	144963.22	9.8597213	10.0209791
22	72377.05	104888.09	144918.98	9.8596009	10.0207262
21	72356.98	104827.02	144874.78	9.8594804	10.0204732
20	72336.90	104765.98	144830.63	9.8593599	10.0202203
19	72316.81	104704.98	144786.51	9.8592393	10.0199674
18	72296.71	104644.02	144742.43	9.8591186	10.0197144
17	72276.61	104583.10	144698.39	9.8589978	10.0194615
16	72256.51	104522.21	144654.39	9.8588770	10.0192086
15	72236.40	104461.36	144610.43	9.8587561	10.0189557
14	72216.28	104400.55	144566.51	9.8586351	10.0187028
13	72296.15	104339.77	144522.62	9.8585141	10.0184499
12	72176.02	104279.04	144478.78	9.8583929	10.0181970
11	72155.89	104218.33	144434.97	9.8582718	10.0179441
10	72135.74	104157.67	144391.20	9.8581505	10.0176913
9	72115.59	104097.04	144347.48	9.8580292	10.0174384
8	72095.44	104036.45	144303.79	9.8579078	10.0171855
7	72075.28	103975.89	144260.13	9.8577863	10.0169327
6	72055.11	103915.37	144216.52	9.8576648	10.0166798
5	72034.94	103854.89	144172.95	9.8575432	10.0164270
4	72014.76	104394.45	144129.41	9.8574215	10.0161741
3	71994.57	103734.04	144085.91	9.8572998	10.0159213
2	71974.38	103673.67	144042.46	9.8571779	10.0156685
1	71954.18	103613.33	143999.04	9.8570561	10.0154156
0	71933.98	103553.03	143955.65	9.8569341	10.0151628

44 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
0	69465.84	96568.88	139016.36	9.8417713	9.9848372
1	69486.76	96625.11	139055.43	9.8419021	9.9850900
2	69507.67	96681.37	139094.53	9.8420328	9.9853428
3	69528.58	96737.67	139133.66	9.8421634	9.9855956
4	69549.49	96794.00	139172.83	9.8422939	9.9858484
5	69570.39	96850.35	139212.03	9.8424244	9.9861012
6	69591.28	96906.74	139251.27	9.8425548	9.9863540
7	69612.17	96963.16	139290.54	9.8426851	9.9866068
8	69633.05	97019.62	139329.85	9.8428154	9.9868596
9	69653.92	97076.10	139369.18	9.8429456	9.9871123
10	69674.79	97132.62	139408.56	9.8430757	9.9873651
11	69695.65	97189.17	139447.96	9.8432057	9.9876179
12	69716.51	97245.75	139487.40	9.8433356	9.9878706
13	69737.36	97302.36	139526.88	9.8434655	9.9881234
14	69758.21	97359.01	139566.39	9.8435953	9.9883761
15	69779.05	97415.69	139605.93	9.8437250	9.9886289
16	69799.88	97472.40	139645.51	9.8438547	9.9888816
17	69820.71	97529.14	139685.12	9.8439842	9.9891344
18	69841.53	97585.91	139724.77	9.8441137	9.9893871
19	69862.34	97642.72	139764.45	9.8442432	9.9896399
20	69883.15	97699.56	139804.16	9.8443725	9.9898926
21	69903.96	97756.43	139843.91	9.8445018	9.9901453
22	69924.76	97813.33	139883.69	9.8446310	9.9903981
23	69945.55	97870.27	139923.51	9.8447601	9.9906508
24	69966.33	97927.24	139963.36	9.8448891	9.9909035
25	70987.11	97984.24	140003.25	9.8450181	9.9911562
26	70007.89	98041.27	140043.17	9.8451470	9.9914089
27	70028.66	98098.33	140083.13	9.8452758	9.9916616
28	70049.42	98155.43	140123.12	9.8454045	9.9919143
29	70070.18	98212.56	140163.15	9.8455332	9.9921670
30	70090.93	98269.73	140203.21	9.8456618	9.9924197

45 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang
60	71933.98	103553.03	143955.65	9.8569341	10.0151628
59	71913.77	103492.77	143912.31	9.8568121	10.0149100
58	71893.55	103432.54	143869.00	9.8566900	10.0146572
57	71873.33	103372.35	143825.74	9.8565678	10.0144044
56	71853.10	103312.20	143782.51	9.8564455	10.0141516
55	71832.87	103252.08	143739.32	9.8563232	10.0138988
54	71812.63	103191.99	143696.16	9.8562008	10.0136460
53	71792.38	103131.95	143653.05	9.8560784	10.0133932
52	71772.13	103071.94	143609.97	9.8559558	10.0131404
51	71751.87	103011.96	143566.93	9.8558332	10.0128877
50	71731.61	102952.03	143523.93	9.8557106	10.0126349
49	71711.34	102892.12	143480.97	9.8555878	10.0123821
48	71691.06	102836.26	143438.05	9.8554650	10.0121294
47	71670.78	102772.43	143395.16	9.8553421	10.0118766
46	71650.49	102712.63	143352.31	9.8552192	10.0116239
45	71630.19	102652.87	143309.50	9.8550961	10.0113711
44	71609.89	102593.15	143266.72	9.8549730	10.0111184
43	71589.59	102533.46	143223.99	9.8548499	10.0108656
42	71569.27	102473.81	143181.29	9.8547266	10.0106129
41	71548.95	102414.19	143138.63	9.8546033	10.0103601
40	71528.63	102354.61	143096.00	9.8544799	10.1011074
39	71508.30	102295.06	143053.42	9.8543564	10.0098547
38	71487.96	102235.55	143010.87	9.8542329	10.0096019
37	71467.62	102176.08	142968.36	9.8541099	10.0093492
36	71447.27	102116.64	142925.88	9.8539856	10.0090965
35	71426.91	102057.23	142883.44	9.8538619	10.0088438
34	71406.55	101997.86	142841.04	9.8537381	10.0085911
33	71386.18	101938.53	142798.68	9.8536142	10.0083384
32	71365.81	101879.23	142756.36	9.8534902	10.0080857
31	71345.43	101819.97	142714.07	9.8533662	10.0078330
30	71325.04	101760.74	142671.82	9.8532421	10.0075803

44 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	70090.93	98269.73	140203.21	9.8456618	9.9924197
31	70111.67	98326.92	140243.30	9.8457903	9.9926724
32	70132.41	98384.15	140283.43	9.8459188	9.9929251
33	70153.14	98441.41	140323.60	9.8460471	9.9931778
34	70173.87	98498.71	140363.80	9.8461754	9.9934305
35	70194.59	98556.03	140400.03	9.8463036	9.9936832
36	70215.30	98613.39	140444.30	9.8464318	9.9939359
37	70236.01	98670.79	140484.60	9.8465599	9.9941886
38	70256.72	98728.21	140524.94	9.8466879	9.9944413
39	70277.41	98785.67	140565.32	9.8468158	9.9946940
40	70298.11	98843.16	140605.73	9.8469436	9.9949466
41	70318.79	98900.69	140646.17	9.8470714	9.9951993
42	70339.47	98958.25	140686.65	9.8471991	9.9954520
43	70360.14	99015.84	140727.17	9.8473267	9.9957047
44	70380.81	99073.46	140767.72	9.8474543	9.9959573
45	70401.47	99131.12	140808.31	9.8475817	9.9962100
46	70422.13	99188.81	140848.93	9.8477091	9.9964627
47	70442.78	99246.54	140889.58	9.8478365	9.9967154
48	70463.42	99304.29	140930.28	9.8479637	9.9969680
49	70484.06	99362.08	140975.00	9.8480909	9.9972207
50	70504.69	99419.91	141011.77	9.8482180	9.9974734
51	70525.32	99477.77	141052.56	9.8483450	9.9977260
52	70545.94	99535.66	141093.40	9.8484720	9.9979787
53	70566.55	99593.58	141134.27	9.8485989	9.9982314
54	70587.16	99651.54	141175.17	9.8487257	9.9984840
55	70607.76	99709.53	141216.11	9.8488524	9.9987367
56	70628.35	99767.56	141257.09	9.8489791	9.9989893
57	70648.94	99825.62	141294.10	9.8491057	9.9992420
58	70669.53	99883.71	141339.15	9.8492322	9.9994947
59	70690.11	99941.84	141380.24	9.8493586	9.9997473
60	70710.68	90000.00	141421.36	9.8494850	10.0000000

45 Degrees.

Minutes.	Sines.	Tangents.	Secants.	Log. Sin.	Log. Tang.
30	71325.04	101760.74	142671.82	9.8532421	10.0075803
29	71304.65	101701.55	142629.61	9.8531179	10.0073276
28	71284.26	101642.39	142587.43	9.8529936	10.0070749
27	71263.85	101583.26	142545.29	9.8528693	10.0068222
26	71243.44	101524.17	142503.19	9.8527449	10.0065695
25	71223.03	101465.12	142461.12	9.8526204	10.0063168
24	71202.00	101406.10	142419.09	9.8524959	10.0060641
23	71182.18	101347.12	142377.10	9.8523713	10.0058114
22	71161.74	101288.17	142335.14	9.8522466	10.0055587
21	71141.30	101229.25	142293.23	9.8521218	10.0053060
20	71120.86	101170.37	142251.34	9.8519970	10.0050534
19	71100.41	101111.53	142209.50	9.8518721	10.0048007
18	71076.95	101052.72	142167.69	9.8517471	10.0045480
17	71059.48	100993.94	142125.92	9.8516220	10.0042953
16	71039.01	100935.20	142084.18	9.8514969	10.0040427
15	71018.54	100876.49	142042.48	9.8513717	10.0037900
14	70998.06	100817.82	142000.82	9.8512465	10.0035373
13	70977.57	100759.18	141959.19	9.8511218	10.0032846
12	70957.07	100700.58	141917.61	9.8509957	10.0030320
11	70936.57	100642.01	141876.05	9.8508702	10.0027793
10	70916.07	100583.47	141834.54	9.8507446	10.0025266
9	70895.56	100524.97	141793.05	9.8506190	10.0022740
8	70875.04	100466.51	141751.61	9.8504933	10.0020213
7	70854.51	100408.07	141710.20	9.8503675	10.0017686
6	70833.98	100349.68	141668.83	9.8502417	10.0015160
5	70813.45	100291.31	141627.49	9.8501157	10.0012633
4	70792.91	100232.98	141586.19	9.8499897	10.0010107
3	70772.36	100174.69	141544.93	9.8498637	10.0007580
2	70751.80	100116.42	141503.70	9.8497375	10.0005053
1	70731.24	100058.19	141462.51	9.8496113	10.0002527
0	70710.68	100000.00	141421.36	9.8494850	10.0000000

A
TABLE
OF
LOGARITHMS
FOR
Natural Numbers,
From 1, to 10.000.

A Table of Logarithms.

N.	*Logarith.*	N.	*Logarith.*	N.	*Logarith.*
1	0.0000000	34	1.5314789	67	1.8260748
2	0.3010300	35	1.5440680	68	1.8325089
3	0.4771213	36	1.5563025	69	1.8388491
4	0.6020600	37	1.5682017	70	1.8450980
5	0.6989700	38	1.5797836	71	1.8512583
6	9.7781512	39	1.5910646	72	1.8573325
7	0.8450980	40	1.6020600	73	1.8633229
8	0.9030900	41	1.6127839	74	1.8692317
9	0.9542425	42	1.6232493	75	1.8750613
10	1.0000000	43	1.6334685	76	1.8808136
11	1.0413927	44	1.6434527	77	1.8864907
12	1.0791812	45	1.6532125	78	1.8920946
13	1.1139433	46	1.6627578	79	1.8976271
14	1.1461280	47	1.6720979	80	1.9030900
15	1.1760913	48	1.6812412	81	1.9084850
16	1.2041200	49	1.6901961	82	1.9138138
17	1.2304489	50	1.6989700	83	1.9190781
18	1.2552725	51	1.7075702	84	1.9242793
19	1.2787536	52	1.7160033	85	1.9294189
20	1.3010300	53	1.7242759	86	1.9344984
21	1.3222193	54	1.7323938	87	1.9395192
22	1.3424227	55	1.7403627	88	1.9444827
23	1.3617278	56	1.7481880	89	1.9493900
24	1.3802112	57	1.7558749	90	.9542425
25	1.3979400	58	1.7634280	91	1.9590414
26	1.4149733	59	1.7708520	92	1.9637878
27	1.4313638	60	1.7781512	93	1.9684829
28	1.4471580	61	1.7853298	94	1.9731279
29	1.4623980	62	1.7923917	95	1.9777236
30	1.4771213	63	1.7993405	96	1.9822712
31	1.4913617	64	1.8061800	97	1.9867717
32	1.5051500	65	1.8129134	98	1.9912261
33	1.5185139	66	1.8195439	99	1.9956352
34	1.5314789	67	1.8260748	100	2.0000000

N.	*Logarith.*	*N.*	*Logarith.*	*N.*	*Logarith.*
101	2.0043214	134	2.1271048	167	2.2227165
102	2.0086002	135	2.1303338	168	2.2253093
103	2.0120372	136	2.1335389	169	2.2278867
104	2.0178333	137	2.1367206	170	2.2304489
105	2.0211893	138	2.1398791	171	2.2329961
106	2.0253059	139	2.1430148	172	2.2355284
107	2.0293838	140	2.1461280	173	2.2380461
108	2.0334238	141	2.1492191	174	2.2405492
109	2.0374265	142	2.1522883	175	2.2430380
110	2.0413927	143	2.1553360	176	2.2455127
111	2.0453230	144	2.1583625	177	2.2479733
112	2.0492180	145	2.1613680	178	2.2504200
113	2.0530784	146	2.1643529	179	2.2528530
114	2.0569049	147	2.1673173	180	2.2552725
115	2.0606978	148	2.1702617	181	2.2576786
116	2.0644580	149	2.1731863	182	2.2600714
117	2.0681859	150	2.1760913	183	2.2624511
118	2.0718820	151	2.1789769	184	2.2648178
119	2.0755470	152	2.1818436	185	2.2671717
120	2.0791812	153	2.1846914	186	2.2695129
121	2.0827854	154	2.1875207	187	2.2718416
122	2.0863598	155	2.1903317	188	2.2741578
123	2.0899051	156	2.1931246	189	2.2764618
124	2.0934217	157	2.1958996	190	2.2787536
125	2.0969100	158	2.1986571	191	2.2810334
126	2.1003705	159	2.2013971	192	2.2833012
127	2.1038037	160	2.2041200	193	2.2855573
128	2.1072100	161	2.2068259	194	2.2878017
129	2.1105897	162	2.2095150	195	2.2900346
130	2.1139433	163	2.2121876	196	2.2922561
131	2.1172713	164	2.2148438	197	2.2944662
132	2.1205739	165	2.2174839	198	2.2966652
133	2.1238516	166	2.2201081	199	2.2988531
134	2.1271048	167	2.2227165	200	2.3010300

N.	Logarith.	N.	Logarith.	N.	Logarith.
201	2.3031961	234	2.3692159	267	2.4265113
202	2.3053514	235	2.3710679	268	2.4281348
203	2.3074960	236	2.3729120	269	2.4297523
204	2.3096302	237	2.3747483	270	2.4313638
205	2.3117539	238	2.3765770	271	2.4329693
206	2.3138672	239	2.3783979	272	2.4345689
207	2.3159703	240	2.3802112	273	2.4361626
208	2.3180633	241	2.3820170	274	2.4377506
209	2.3201463	242	2.3838154	275	2.4393327
210	2.3222193	243	2.3856063	276	2.4409091
211	2.3242825	244	2.3873898	277	2.4424798
212	2.3263359	245	2.3891661	278	2.4440448
213	2.3283796	246	2.3909351	279	2.4456042
214	2.3304138	247	2.3926970	280	2.4471580
215	2.3324385	248	2.3944517	281	2.4487063
216	2.3344537	249	2.3961993	282	2.4502491
217	2.3364597	250	2.3979400	283	2.4517864
218	2.3384565	251	2.3996737	284	2.4533183
219	2.3404441	252	2.4014005	285	2.4548449
220	2.3424227	253	2.4031205	286	2.4563660
221	2.3443923	254	2.4048337	287	2.4578819
222	2.3463530	255	2.4065402	288	2.4593925
223	2.3483049	256	2.4082400	289	2.4608978
224	2.3502480	257	2.4099331	290	2.4623980
225	2.3521825	258	2.4116197	291	2.4638930
226	2.3541084	259	2.4132998	292	2.4653828
227	2.3560259	260	2.4149733	293	2.4668676
228	2.3579348	261	2.4166405	294	2.4683473
229	2.3598355	262	2.4183013	295	2.4698220
230	2.3617278	263	2.4199557	296	2.4712917
231	2.3636120	264	2.4216039	297	2.4727564
232	2.3654880	265	2.4232459	298	2.4742163
233	2.3673559	266	2.4248816	299	2.4756712
234	2.3692159	267	2.4265113	300	2.4771213

N.	Logarith.	N.	Logarith.	N.	Logarith
301	2.4785665	334	2.5237465	367	2.5646661
302	2.4800069	335	2.5250448	368	2.5658478
303	2.4814426	336	2.5263393	369	2.5670264
304	2.4828736	337	2.5276299	370	2.5682017
305	2.4842998	338	2.5289167	371	2.5693739
306	2.4857214	339	2.5301997	372	2.5705429
307	2.4871384	340	2.5314789	373	2.5717088
308	2.4885507	341	2.5327544	374	2.5728716
309	2.4899585	342	2.5340261	375	2.5740313
310	2.4913617	343	2.5352941	376	2.5751878
311	2.4927604	344	2.5365584	377	2.5763413
312	2.4941546	345	2.5378191	378	2.5774918
313	2.4955443	346	2.5390761	379	2.5786392
314	2.4969296	347	2.5403295	380	2.5797836
315	2.4983106	348	2.5415792	381	2.5809250
316	2.4996871	349	2.5428254	382	2.5820634
317	2.5010593	350	2.5440680	383	2.5831988
318	2.5024271	351	2.5453071	384	2.5843312
319	2.5037907	352	2.5465427	385	2.5854607
320	2.5051500	353	2.5477747	386	2.5865873
321	2.5065050	354	2.5490033	387	2.5877110
322	2.5078559	355	2.5502284	388	2.5888317
323	2.5092025	356	2.5514500	389	2.5899496
324	2.5105450	357	2.5526682	390	2.5910646
325	2.5118834	358	2.5538830	391	2.5921768
326	2.5132176	359	2.5550944	392	2.5932861
327	2.5145477	360	2.5563025	393	3.5943925
328	2.5158738	361	2.5575072	394	2.5954962
329	2.5171959	362	2.5587086	395	2.5965971
330	2.5185139	363	2.5599066	396	2.5976952
331	2.5198280	364	2.5611014	397	2.5987905
332	2.5211381	365	2.5622929	398	2.5998831
333	2.5224442	366	2.5634811	399	2.6009729
334	2.5237465	367	2.5646661	400	2.6020600

N.	Logarith.	N.	Logarith.	N.	Logarith.
401	2.6031444	434	2.6374897	467	2.6693169
402	2.6042261	435	2.6384893	468	2.6702459
403	2.6053050	436	2.6394865	469	2.6711728
404	2.6063814	437	2.6404814	470	2.6720979
405	2.6074550	438	2.6414741	471	2.6730209
406	2.6085260	439	2.6424645	472	2.6739420
407	2.6095944	440	2.6434527	473	2.6748611
408	2.6106602	441	2.6444386	474	2.6757783
409	2.6117233	442	2.6454223	475	2.6766936
410	2.6127839	443	2.6464037	476	2.6776069
411	2.6138418	444	2.6473830	477	2.6785184
412	2.6148972	445	2.6483600	478	2.6794279
413	2.6159500	446	2.6493349	479	2.6803355
414	2.6170003	447	2.6503075	480	2.6812412
415	2.6180481	448	2.6512780	481	2.6821451
416	2.6190933	449	2.6522463	482	2.6830470
417	2.6201361	450	2.6532125	483	2.6839471
418	2.6211763	451	2.6541765	484	2.6848454
419	2.6222140	452	2.6551384	485	2.6857417
420	2.6232493	453	2.6560982	486	2.6866363
421	2.6242821	454	2.6570558	487	2.6875290
422	2.6253124	455	2.6580114	488	2.6884198
423	2.6263404	456	2.6589648	489	2.6893089
424	2.6273659	457	2.6599162	490	2.6901961
425	2.6283889	458	2.6608655	491	2.6910815
426	2.6294096	459	2.6618127	492	2.6919651
427	2.6304279	460	2.6627578	493	2.6928469
428	2.6314438	461	2.6637009	494	2.6937269
429	2.6324573	462	2.6646420	495	2.6946052
430	2.6334685	463	2.6655810	496	2.6954817
431	2.6344773	464	2.6665180	497	2.6963564
432	2.6354837	465	2.6674529	498	2.6972293
433	2.6364879	466	2.6683859	499	2.6981005
434	2.6374897	467	2.6693169	500	2.6989700

N.	Logarith.	N.	Logarith.	N.	Logarith.
501	2.6998377	534	2.7275413	567	2.7535831
502	2.7007037	535	2.7283538	568	2.7543483
503	2.7015680	536	2.7291648	569	2.7551123
504	2.7024305	537	2.7299743	570	2.7558749
505	2.7032914	538	2.7307823	571	2.7566361
506	2.7041505	539	2.7315888	572	2.7573960
507	2.7050080	540	2.7323938	573	2.7581546
508	2.7058637	541	2.7331973	574	2.7589119
509	2.7067178	542	2.7339993	575	2.7596678
510	2.7075702	543	2.7347998	576	2.7604225
511	2.7084209	544	2.7355989	577	2.7611758
512	2.7092700	545	2.7363965	578	2.7619278
513	2.7101174	546	2.7371926	579	2.7626786
514	2.7109631	547	2.7379873	580	2.7634280
515	2.7118072	548	2.7387806	581	2.7641761
516	2.7126497	549	2.7395723	582	2.7649230
517	2.7134905	550	2.7403627	583	2.7656686
518	2.7143298	551	2.7411516	584	2.7664128
519	2.7151674	552	2.7419391	585	2.7671559
520	2.7160033	553	2.7427251	586	2.7678976
521	2.7168377	554	2.7435098	587	2.7686381
522	2.7176705	555	2.7442930	588	2.7693773
523	2.7185017	556	2.7450748	589	2.7701153
524	2.7193313	557	2.7458552	590	2.7708520
525	2.7201593	558	2.7466342	591	2.7715875
526	2.7209857	559	2.7474118	592	2.7723217
527	2.7218106	560	2.7481880	593	2.7730547
528	2.7226339	561	2.7489629	594	2.7737864
529	2.7234557	562	2.7497363	595	2.7745170
530	2.7242759	563	2.7505084	596	2.7752463
531	2.7250945	564	2.7512791	597	2.7759743
532	2.7259116	565	2.7520484	598	2.7767012
533	2.7267272	566	2.7528164	599	2.7774268
534	2.7275413	567	2.7535831	600	2.7781512

N.	Logarith.	N.	Logarith.	N.	Logarith.
601	2.7788745	634	2.8020893	667	2.8241258
602	2.7795965	635	2.8027737	668	2.8247765
603	2.7803173	636	2.8034571	669	2.8254261
604	2.7810369	637	2.8041394	670	2.8260748
605	2.7817554	638	2.8048207	671	2.8267225
606	2.7824726	639	2.8055009	672	2.8273693
607	2.7831887	640	2.8061800	673	2.8280151
608	2.7839036	641	2.8068580	674	2.8286599
609	2.7846173	642	2.8075350	675	2.8293038
610	2.7853298	643	2.8082110	676	2.8299467
611	2.7860412	644	2.8088859	677	2.8305887
612	2.7867514	645	2.8095597	678	2.8312297
613	2.7874605	646	2.8102325	679	2.8318698
614	2.7881684	647	2.8109043	680	2.8325089
615	2.7888751	648	2.8115750	681	2.8331471
616	2.7895807	649	2.8122447	682	2.8337844
617	2.7902852	650	2.8129134	683	2.8344207
618	2.7909885	651	2.8135810	684	2.8350561
619	2.7916906	652	2.8142476	685	2.8356906
620	2.7923917	653	2.8149132	686	2.8363241
621	2.7930916	654	2.8155777	687	2.8369567
622	2.7937904	655	2.8162413	688	2.8375884
623	2.7944880	656	2.8169038	689	2.8382192
624	2.7951846	657	2.8175654	690	2.8388491
625	2.7958800	658	2.8182259	691	2.8394780
626	2.7965743	659	2.8188854	692	2.8401061
627	2.7972675	660	2.8195439	693	2.8407332
628	2.7979596	661	2.8202015	694	2.8413595
629	2.7986506	662	2.8208580	695	2.8419848
630	2.7993405	663	2.8215135	696	2.8426092
631	2.8000294	664	2.8221681	697	2.8432328
632	2.8007171	665	2.8228216	698	2.8438554
633	2.8014037	666	2.8234742	699	2.8444772
634	2.8020893	667	2.8241258	700	2.8450980

N.	Logarith.	N.	Logarith.	N.	Logarith.
701	2.8457180	734	2.8656961	767	2.8847954
702	2.8463371	735	2.8662873	768	2.8853612
703	2.8469553	736	2.8668778	769	2.8859263
704	2.8475727	737	2.8674675	770	2.8864907
705	2.8481891	738	2.8680564	771	2.8870544
706	2.8488047	739	2.8686444	772	2.8876173
707	2.8494194	740	2.8692317	773	2.8881795
708	2.8500333	741	2.8698182	774	2.8887410
709	2.8506462	742	2.8704039	775	2.8893017
710	2.8512583	743	2.8709888	776	2.8898617
711	2.8518696	744	2.8715729	777	2.8904210
712	2.8524800	745	2.8721563	778	2.8909796
713	2.8530895	746	2.8727388	779	2.8915375
714	2.8536982	747	2.8733206	780	2.8920946
715	2.8543060	748	2.8739016	781	2.8926510
716	2.8549130	749	2.8744818	782	2.8932068
717	2.8555192	750	2.8750613	783	2.8937618
718	2.8561244	751	2.8756399	784	2.8943161
719	2.8567289	752	2.8762178	785	2.8948697
720	2.8573325	753	2.8767950	786	2.8954225
721	2.8579353	754	2.8773713	787	2.8959747
722	2.8585372	755	2.8779469	788	2.8965262
723	2.8591383	756	2.8785218	789	2.8970770
724	2.8597386	757	2.8790959	790	2.8976271
725	2.8603380	758	2.8796692	791	2.8981765
726	2.8609366	759	2.8802418	792	2.8987252
727	2.8615344	760	2.8808136	793	2.8992732
728	2.8621314	761	2.8813847	794	2.8998205
729	2.8627275	762	2.8819550	795	2.9003671
730	2.8633229	763	2.8825245	796	2.9009131
731	2.8639174	764	2.8830934	797	2.9014583
732	2.8645111	765	2.8836614	798	2.9020029
733	2.8651040	766	2.8842288	799	2.9025468
734	2.8656961	767	2.8847954	800	2.9030900

N.	Logarith.	N.	Logarith.	N.	Logarith.
801	2.9036325	834	2.9211660	867	2.9380191
802	2.9041744	835	2.9216865	868	2.9385197
803	2.9047155	836	2.9222063	869	2.9390198
804	2.9052560	837	2.9227255	870	2.9395192
805	2.9057959	838	2.9232440	871	2.9400181
806	2.9063350	839	2.9237620	872	2.9405165
807	2.9068735	840	2.9242793	873	2.9410142
808	2.9074114	841	2.9247960	874	2.9415114
809	2.9079485	842	2.9253121	875	2.9420080
810	2.9084850	843	2.9258276	876	2.9425041
811	2.9090209	844	2.9263424	877	2.9429996
812	2.9095560	845	2.9268567	878	2.9434945
813	2.9100905	846	2.9273704	879	2.9439889
814	2.9106244	847	2.9278834	880	2.9444827
815	2.9111576	848	2.9283958	881	2.9449759
816	2.9116902	849	2.9289077	882	2.9454686
817	2.9122221	850	2.9294189	883	2.9459607
818	2.9127533	851	2.9299296	884	2.9464523
819	2.9132839	852	2.9304396	885	2.9469433
820	2.9138138	853	2.9309490	886	2.9474337
821	2.9143432	854	2.9314579	887	2.9479236
822	2.9148718	855	2.9319661	888	2.9484130
823	2.9153998	856	2.9324738	889	2.9489018
824	2.9159272	857	2.9329808	890	2.9493900
825	2.9164539	858	2.9334873	891	2.9498777
826	2.9169800	859	2.9339932	892	2.9503648
827	2.9175055	860	2.9344984	893	2.9508514
828	2.9180303	861	2.9350031	894	2.9513375
829	2.9185545	862	2.9355073	895	2.9518230
830	2.9190781	863	2.9360108	896	2.9523080
831	2.9196010	864	2.9365137	897	2.9527924
832	2.9201233	865	2.9370161	898	2.9532763
833	2.9206450	866	2.9375179	899	2.9537597
834	2.9211660	867	2.9380191	900	2.9542425

N.	Logarith.	N.	Logarith.	N.	Logarith.
901	2.9547248	934	2.9703469	967	2.9854265
902	2.9552065	935	2.9708116	968	2.9858754
903	2.9556877	936	2.9712758	969	2.9863238
904	2.9561684	937	2.9717396	970	2.9867717
905	2.9566486	938	2.9722028	971	2.9872192
906	2.9571282	939	2.9726656	972	2.9876663
907	2.9576073	940	2.9731279	973	2.9881128
908	2.9580858	941	2.9735896	974	2.9885590
909	2.9585639	942	2.9740509	975	2.9890046
910	2.9590414	943	2.9745117	976	2.9894498
911	2.9595184	944	2.9749720	977	2.9898946
912	2.9599948	945	2.9754318	978	2.9903389
913	2.9604708	946	2.9758911	979	2.9907827
914	2.9609462	947	2.9763500	980	2.9912261
915	2.9614211	948	2.9768083	981	2.9916690
916	2.9618955	949	2.9772662	982	2.9921115
917	2.9623693	950	2.9777236	983	2.9925535
918	2.9628427	951	2.9781805	984	2.9929951
919	2.9633155	952	2.9786369	985	2.9934362
920	2.9637878	953	2.9790929	986	2.9938769
921	2.9642596	954	2.9795484	987	2.9943171
922	2.9647309	955	2.9800034	988	2.9947569
923	2.9652017	956	2.9804579	989	2.9951963
924	2.9656720	957	2.9809119	990	2.9956352
925	2.9661417	958	2.9813655	991	2.9960737
926	2.9666110	959	2.9818186	992	2.9965117
927	2.9670797	960	2.9822712	993	2.9969492
928	2.9675480	961	2.9827234	994	2.9973864
929	2.9680157	962	2.9831751	995	2.9978231
930	2.9684829	963	2.9836263	996	2.9982593
931	2.9689497	964	2.9840770	997	2.9986952
932	2.9694159	965	2.9845273	998	2.9991305
933	2.9698816	966	2.9849771	999	2.9995655
934	2.9703469	967	2.9854265	1000	3.0000000

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1001	3.0004341	1034	3.0145205	1067	3.0281644
1002	3.0008677	1035	3.0149403	1068	3.0285712
1003	3.0013009	1036	3.0153598	1069	3.0289777
1004	3.0017337	1037	3.0157788	1070	3.0293838
1005	3.0021661	1038	3.0161974	1071	3.0297895
1006	3.0025980	1039	3.0166155	1072	3.0301948
1007	3.0030295	1040	3.0170333	1073	3.0305997
1008	3.0034605	1041	3.0174507	1074	3.0310043
1009	3.0038912	1042	3.0178677	1075	3.0314085
1010	3.0043214	1043	3.0182443	1076	3.0318123
1011	3.0047512	1044	3.0187005	1077	3.0322157
1012	3.0051805	1045	3.0191163	1078	3.0326188
1013	3.0056094	1046	3.0195317	1079	3.0330214
1014	3.0060380	1047	3.0199467	1080	3.0334238
1015	3.0064660	1048	3.0203613	1081	3.0338257
1016	3.0068937	1049	3.0207755	1082	3.0342273
1017	3.0073209	1050	3.0211893	1083	3.0346285
1018	3.0073478	1051	3.0216027	1084	3.0350293
1019	3.0081742	1052	3.0220157	1085	3.0354297
1020	3.0086002	1053	3.0224284	1086	3.0358298
1021	3.0090257	1054	3.0228406	1087	3.0362295
1022	3.0094509	1055	3.0232525	1088	3.0366289
1023	3.0098756	1056	3.0236639	1089	3.0370279
1024	3.0103000	1057	3.0240750	1090	3.0374265
1025	3.0107239	1058	3.0244857	1091	3.0378247
1026	3.0111474	1059	3.0248960	1092	3.0382226
1027	3.0115704	1060	3.0253059	1093	3.0386202
1028	3.0119931	1061	3.0257154	1094	3.0390173
1029	3.0124154	1062	3.0261245	1095	3.0394141
1030	3.0128372	1063	3.0265333	1096	3.0398106
1031	3.0132587	1064	3.0269416	1097	3.0402066
1032	3.0136797	1065	3.0273496	1098	3.0406023
1033	3.0141003	1066	3.0277572	1099	3.0409977
1034	3.0145205	1067	3.0281644	1100	3.0413927

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1101	3.0417873	1134	3.0546131	1167	3.0670709
1102	3.0421816	1135	3.0549959	1168	3.0674428
1103	3.0425755	1136	3.0553783	1169	3.0678145
1104	3.0429691	1137	3.0557605	1170	3.0681859
1105	3.0433623	1138	3.0561423	1171	3.0685569
1106	3.0437551	1139	3.0565237	1172	3.0689276
1107	3.0441476	1140	3.0569048	1173	3.0692980
1108	3.0445398	1141	3.0572856	1174	3.0696681
1109	3.0449315	1142	3.0576661	1175	3.0700379
1110	3.0453230	1143	3.0580462	1176	3.0704073
1111	3.0457141	1144	3.0584260	1177	3.0707765
1112	3.0461048	1145	3.0588055	1178	3.0711453
1113	3.0464952	1146	3.0591846	1179	3.0715138
1114	3.0468852	1147	3.0595634	1180	3.0718820
1115	3.0472749	1148	3.0599419	1181	3.0722499
1116	3.0476642	1149	3.0603200	1182	3.0726175
1117	3.0480532	1150	3.0606978	1183	3.0729847
1118	3.0484418	1151	3.0610753	1184	3.0733517
1119	3.0488301	1152	3.0614525	1185	3.0737183
1120	3.0492180	1153	3.0618293	1186	3.0740847
1121	3.0496056	1154	3.0622058	1187	3.0744507
1122	3.0499929	1155	3.0625820	1188	3.0748164
1123	3.0503798	1156	3.0629578	1189	3.0751818
1124	3.0507663	1157	3.0633334	1190	3.0755470
1125	3.0511525	1158	3.0637086	1191	3.0759119
1126	3.0515384	1159	3.0640834	1192	3.0762763
1127	3.0519239	1160	3.0644580	1193	3.0766404
1128	3.0523091	1161	3.0648322	1194	3.0770043
1129	3.0526939	1162	3.0652061	1195	3.0773679
1130	3.0530784	1163	3.0655797	1196	3.0777312
1131	3.0534626	1164	3.0659530	1197	3.0780941
1132	3.0538464	1165	3.0663259	1198	3.0784568
1133	3.0542299	1166	3.0666985	1199	3.0788192
1134	3.0536131	1167	3.0670709	1200	3.0791812

N.	Logarith.	N.	Logarith.	N.	Logarith.
1201	3.0795430	1234	3.0913152	1267	3.1027766
1202	3.0799045	1235	3.0916670	1268	3.1031192
1203	3.0802626	1236	3.0920185	1269	3.1034616
1204	3.0806268	1237	3.0923697	1270	3.1038037
1205	3.0809870	1238	3.0927206	1271	3.1041455
1206	3.0813473	1239	3.0930712	1272	3.1044871
1207	3.0817073	1240	3.0934217	1273	3.1048284
1208	3.0820669	1241	3.0937718	1274	3.1051694
1209	3.0824263	1242	3.0941216	1275	3.1055102
1210	3.0827854	1243	3.0944711	1276	3.1058507
1211	3.0831441	1244	3.0940204	1277	3.1061909
1212	3.0835026	1245	3.0951693	1278	3.1065308
1213	3.0838608	1246	3.0955180	1279	3.1068705
1214	3.0842187	1247	3.0958664	1280	3.1072100
1215	3.0845763	1248	3.0962146	1281	3.1075491
1216	3.0849336	1249	3.0965624	1282	3.1078880
1217	3.0852906	1250	3.0961100	1283	3.1082266
1218	3.0856473	1251	3.0972573	1284	3.1085650
1219	3.0860037	1252	3.0976043	1285	3.1089031
1220	3.0863598	1253	3.0979511	1286	3.1092410
1221	3.0867157	1254	3.0982975	1287	3.1095785
1222	3.0870712	1255	3.0986437	1288	3.1099159
1223	3.0874265	1256	3.0989896	1289	3.1102529
1224	3.0877814	1257	3.0993351	1290	3.1105897
1225	3.0881361	1258	3.0996806	1291	3.1109262
1226	3.0884905	1259	3.1000257	1292	3.1112625
1227	3.0888446	1260	3.1003705	1293	3.1115985
1228	3.0891984	1261	3.1007151	1294	3.1119343
1229	3.0895519	1262	3.1010594	1295	3.1122698
1230	3.0899051	1263	3.1014033	1296	3.1126050
1231	3.0902580	1264	3.1017471	1297	3.1129400
1232	3.0906107	1265	3.1020905	1298	3.1132746
1233	3.0909631	1266	3.1024337	1299	3.1136091
1234	3.0913152	1267	3.1027766	1300	3.1139433

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1301	3.1142773	1334	3.1251558	1367	3.1357685
1302	3.1146110	1335	3.1254813	1368	3.1360861
1303	3.1149444	1336	3.1258065	1369	3.1364034
1304	3.1152776	1337	3.1261314	1370	3.1367206
1305	3.1156105	1338	3.1264561	1371	3.1370375
1306	3.1159432	1339	3.1267806	1372	3.1373541
1307	3.1162756	1340	3.1271048	1373	3.1376705
1308	3.1166077	1341	3.1274288	1374	3.1379867
1309	3.1169396	1342	3.1277525	1375	3.1383027
1310	3.1172713	1343	3.1280760	1376	3.1386184
1311	3.1176027	1344	3.1283993	1377	3.1389339
1312	3.1179338	1345	3.1287223	1378	3.1392492
1313	3.1182647	1346	3.1290451	1379	3.1395643
1314	3.1185954	1347	3.1293676	1380	3.1398791
1315	3.1189257	1348	3.1296899	1381	3.1401937
1316	3.1192559	1349	3.1300119	1382	3.1405080
1317	2.1195858	1350	3.1303338	1383	3.1408222
1318	3.1199154	1351	3.1306553	1384	3.1411361
1319	3.1202448	1352	3.1309767	1385	3.1414498
1320	3.1205739	1353	3.1312978	1386	3.1417632
1321	3.1209028	1354	3.1316187	1387	3.1420765
1322	3.1212315	1355	3.1319393	1388	3.1423895
1323	3.1215598	1356	3.1322597	1389	3.1427022
1324	3.1218880	1357	3.1325798	1390	3.1430148
1325	3.1222159	1358	3.1328998	1391	3.1433271
1326	3.1225435	1359	3.1332195	1392	3.1436392
1327	3.1228709	1360	3.1335389	1393	3.1439511
1328	3.1231981	1361	3.1338581	1394	3.1442628
1329	3.1235250	1362	3.1341771	1395	3.1445742
1330	3.1238516	1363	3.1344959	1396	3.1448854
1331	3.1241781	1364	3.1348144	1397	3.1451964
1332	3.1245042	1365	3.1351326	1398	3.1455072
1333	3.1248301	1366	3.1354507	1399	3.1458177
1334	3.1251558	1367	3.1357685	1400	3.1461280

N.	Logarith.	N.	Logarith.	N.	Logarith.
1401	3.1464381	1434	3.1565491	1467	3.1664301
1402	3.1467480	1435	3.1568519	1468	3.1667261
1403	3.1470577	1436	3.1571544	1469	3.1670218
1404	3.1473671	1437	3.1574568	1470	3.1673173
1405	3.1476763	1438	3.1577589	1471	3.1676127
1406	3.1479853	1439	3.1580608	1472	3.1679078
1407	3.1482941	1440	3.1583625	1473	3.1682027
1408	3.1486027	1441	3.1586640	1474	3.1684975
1409	3.1489110	1442	3.1589653	1475	3.1687920
1410	3.1492191	1443	3.1592663	1476	3.1690864
1411	3.1495270	1444	3.1595672	1477	3.1693805
1412	3.1498347	1445	3.1598678	1478	3.1696744
1413	3.1501422	1446	3.1601683	1479	3.1699682
1414	3.1504494	1447	3.1604685	1480	3.1702617
1415	3.1507564	1448	3.1607686	1481	3.1705551
1416	3.1510633	1449	3.1610684	1482	3.1708482
1417	3.1513698	1450	3.1613680	1483	3.1711411
1418	3.1516762	1451	3.1616674	1484	3.1714339
1419	3.1519824	1452	3.1619666	1485	3.1717265
1420	3.1522883	1453	3.1622656	1486	3.1720188
1421	3.1525941	1454	3.1625644	1487	3.1723110
1422	3.1528996	1455	3.1628630	1488	3.1726029
1423	3.1532049	1456	3.1631614	1489	3.1728947
1424	3.1535100	1457	3.1634596	1490	3.1731863
1425	3.1538149	1458	3.1637575	1491	3.1734776
1426	3.1541195	1459	3.1640553	1492	3.1737688
1427	3.1544240	1460	3.1643529	1493	3.1740598
1428	3.1547282	1461	3.1646502	1494	3.1743506
1429	3.1550322	1462	3.1649474	1495	3.1746412
1430	3.1553360	1463	3.1652443	1496	3.1749431
1431	3.1556396	1464	3.1655411	1497	3.1752218
1432	3.1559430	1465	3.1658376	1498	3.1755118
1433	3.1562462	1466	3.1661340	1499	3.1758016
1434	3.1565491	1467	3.1664301	1500	3.1760913

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1501	3.1763807	1534	3.1858254	1567	3.1950690
1502	3.1766699	1535	3.1861084	1568	3.1953461
1503	3.1769590	1536	3.1863912	1569	3.1956229
1504	3.1772478	1537	3.1866739	1570	3.1958996
1505	3.1775365	1538	3.1869563	1571	3.1961762
1506	3.1778250	1539	3.1872386	1572	3.1964525
1507	3.1781132	1540	3.1875207	1573	3.1967287
1508	3.1784013	1541	3.1878026	1574	3.1970047
1509	3.1786892	1542	3.1880844	1575	3.1972806
1510	3.1789769	1543	3.1883659	1576	3.1975562
1511	3.1792645	1544	3.1886473	1577	3.1978317
1512	3.1795518	1545	3.1889285	1578	3.1981070
1513	3.1798389	1546	3.1892095	1579	3.1983821
1514	3.1801259	1547	3.1894903	1580	3.1986571
1515	3.1804126	1548	3.1897710	1581	3.1989319
1516	3.1806992	1549	3.1900514	1582	3.1992065
1517	3.1809856	1550	3.1903317	1583	3.1994809
1518	3.1812718	1551	3.1906118	1584	3.1997552
1519	3.1815578	1552	3.1908917	1585	3.2000293
1520	3.1818436	1553	3.1911715	1586	3.2003032
1521	3.1821292	1554	3.1914510	1587	3.2005769
1522	3.1824146	1555	3.1917304	1588	3.2008505
1523	3.1826999	1556	3.1920096	1589	3.2011239
1524	3.1829850	1557	3.1922886	1590	3.2013971
1525	3.1832698	1558	3.1925674	1591	3.2016702
1526	3.1835545	1559	3.1928461	1592	3.2019431
1527	3.1838390	1560	3.1931246	1593	3.2022158
1528	3.1841234	1561	3.1934029	1594	3.2024883
1529	3.1844075	1562	3.1936810	1595	3.2027607
1530	3.1846914	1563	3.1939590	1596	3.2030329
1531	3.1849752	1564	3.1942367	1597	3.2033049
1532	3.1852588	1565	3.1945143	1598	3.2035768
1533	3.1855421	1566	3.1947918	1599	3.2038485
1534	3.1858254	1567	3.1950690	1600	3.2041200

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1601	3.2043913	1634	3.2132521	1667	3.2219356
1602	3.2046625	1635	3.2135178	1668	3.2221960
1603	3.2049335	1636	3.2137833	1669	3.2224563
1604	3.2052044	1637	3.2140487	1670	3.2227165
1605	3.2054750	1638	3.2143139	1671	3.2229764
1606	3.2057455	1639	3.2145790	1672	3.2232363
1607	3.2060159	1640	3.2148438	1673	3.2234959
1608	3.2062860	1641	3.2151086	1674	3.2237555
1609	3.2065560	1642	3.2153732	1675	3.2240148
1610	3.2068259	1643	3.2156376	1676	3.2242740
1611	3.2070955	1644	3.2159018	1677	3.2245331
1612	3.2073650	1645	3.2161659	1678	3.2247920
1613	3.2076344	1646	3.2164298	1679	3.2250507
1614	3.2079035	1647	3.2166936	1680	3.2253093
1615	3.2081725	1648	3.2169572	1681	3.2255677
1616	3.2084414	1649	3.2172207	1682	3.2258260
1617	3.2087100	1650	3.2174839	1683	3.2260841
1618	3.2089785	1651	3.2177471	1684	3.2263421
1619	3.2092468	1652	3.2180100	1685	3.2265999
1620	3.2095150	1653	3.2182729	1686	3.2268576
1621	3.2097830	1654	3.2185355	1687	3.2271151
1622	3.2100508	1655	3.2187980	1688	3.2273724
1623	3.2103185	1656	3.2190603	1689	3.2276296
1624	3.2105860	1657	3.2193225	1690	3.2278867
1625	3.2108534	1658	3.2195845	1691	3.2281436
1626	3.2111205	1659	3.2198464	1692	3.2284004
1627	3.2113876	1660	3.2201081	1693	3.2286570
1628	3.2116544	1661	3.2203696	1694	3.2289134
1629	3.2119211	1662	3.2206310	1695	3.2291697
1630	3.2121876	1663	3.2208922	1696	3.2294258
1631	3.2124540	1664	3.2211533	1697	3.2296818
1632	3.2127202	1665	3.2214142	1698	3.2299377
1633	3.2129862	1666	3.2216750	1699	3.2301934
1634	3.2132521	1667	3.2219356	1700	3.2304489

N.	Logarith.	N.	Logarith.	N.	Logarith.
1701	3.2307043	1734	3.2390491	1767	3.2472365
1702	3.2309596	1735	3.2392995	1768	3.2474823
1703	3.2312146	1736	3.2395497	1769	3.2477278
1704	3.2314696	1737	3.2397998	1770	3.2479733
1705	3.2317244	1738	3.2400498	1771	3.2482186
1706	3.2319790	1739	3.2402996	1772	3.2484637
1707	3.2322335	1740	3.2405492	1773	3.2487087
1708	3.2324879	1741	3.2407988	1774	3.2489536
1709	3.2327421	1742	3.2410481	1775	3.2491984
1710	3.2329961	1743	3.2412974	1776	3.2494430
1711	3.2332500	1744	3.2415465	1777	3.2496874
1712	3.2335038	1745	3.2417954	1778	3.2499318
1713	3.2337574	1746	3.2420442	1779	3.2501759
1714	3.2340108	1747	3.2422929	1780	3.2504200
1715	3.2342641	1748	3.2425414	1781	3.2506639
1716	3.2345173	1749	3.2427898	1782	3.2509077
1717	3.2347703	1750	3.2430380	1783	3.2511513
1718	3.2350232	1751	3.2432861	1784	3.2513948
1719	3.2352759	1752	3.2435341	1785	3.2516382
1720	3.2355284	1753	3.2437819	1786	3.2518815
1721	3.2357809	1754	3.2440296	1787	3.2521246
1722	3.2360331	1755	3.2442771	1788	3.2523675
1723	3.2362853	1756	3.2445245	1789	3.2526103
1724	3.2365373	1757	3.2447718	1790	3.2528530
1725	3.2367891	1758	3.2450189	1791	3.2530956
1726	3.2370408	1759	3.2452658	1792	3.2533380
1727	3.2372923	1760	3.2455127	1793	3.2535803
1728	3.2375437	1761	3.2457594	1794	3.2538224
1729	3.2377950	1762	3.2460059	1795	3.2540645
1730	3.2380461	1763	3.2462523	1796	3.2543063
1731	3.2382971	1764	3.2464986	1797	3.2545481
1732	3.2385479	1765	3.2467447	1798	3.2547897
1733	3.2387986	1766	3.2469907	1799	3.2550312
1734	3.2390491	1767	3.2472365	1800	3.2552725

N.	Logarith.	N.	Logarith.	N.	Logarith.
1801	3.2555137	1834	3.2633993	1867	3.2711443
1802	3.2557548	1835	3.2636361	1868	3.2713769
1803	3.2559957	1836	3.2638727	1869	3.2716093
1804	3.2562365	1837	3.2641092	1870	3.2718416
1805	3.2564772	1838	3.2643455	1871	3.2720738
1806	3.2567177	1839	3.2645817	1872	3.2723058
1807	3.2569582	1840	3.2648178	1873	3.2725378
1808	3.2571984	1841	3.2650538	1874	3.2727696
1809	3.2574386	1842	3.2652896	1875	3.2730013
1810	3.2576786	1843	3.2655253	1876	3.2732328
1811	3.2579184	1844	3.2657609	1877	3.2734643
1812	3.2581582	1845	3.2659964	1878	3.2736956
1813	3.2583978	1846	3.2662317	1879	3.2739268
1814	3.2586373	1847	3.2664669	1880	3.2741578
1815	3.2588766	1848	3.2667020	1881	3.2743888
1816	3.2591158	1849	3.2669369	1882	3.2746196
1817	3.2593549	1850	3.2671717	1883	3.2748503
1818	3.2595939	1851	3.2674064	1884	3.2750809
1819	3.2598327	1852	3.2676410	1885	3.2753114
1820	3.2600714	1853	3.2678754	1886	3.2755417
1821	3.2603099	1854	3.2681097	1887	3.2757719
1822	3.2605484	1855	3.2683439	1888	3.2760020
1823	3.2607867	1856	3.2685780	1889	3.2762320
1824	3.2610248	1857	3.2688119	1890	3.2764618
1825	3.2612629	1858	3.2690457	1891	3.2766915
1826	3.2615008	1859	3.2692794	1892	3.2769211
1827	3.2617385	1860	3.2695129	1893	3.2771506
1828	3.2619762	1861	3.2697464	1894	3.2773800
1829	3.2622137	1862	3.2699797	1895	3.2776092
1830	3.2624511	1863	3.2702129	1896	3.2778383
1831	3.2626883	1864	3.2704459	1897	3.2780673
1832	3.2629255	1865	3.2706788	1898	3.2782962
1833	3.2631625	1866	3.2709116	1899	3.2785250
1834	3.2633993	1867	3.2711443	1900	3.2787536

N.	Logarith.	N.	Logarith.	N.	Logarith.
1901	3.2789821	1934	3.2864565	1967	3.2938044
1902	3.2792105	1935	3.2866810	1968	3.2940251
1903	3.2794388	1936	3.2869054	1969	3.2942457
1904	3.2796669	1937	3.2871296	1970	3.2944662
1905	3.2798950	1938	3.2873538	1971	3.2946866
1906	3.2801229	1939	3.2875778	1972	3.2949069
1907	3.2803507	1940	3.2878017	1973	3.2951271
1908	3.2805784	1941	3.2880255	1974	3.2953471
1909	3.2808059	1942	3.2882492	1975	3.2955671
1910	3.2810334	1943	3.2884728	1976	3.2957869
1911	3.2812607	1944	3.2886963	1977	3.2960067
1912	3.2814879	1945	3.2889196	1978	3.2962263
1913	3.2817150	1946	3.2891428	1979	3.2964458
1914	3.2819419	1947	3.2893659	1980	3.2966652
1915	3.2821688	1948	3.2895889	1981	3.2968845
1916	3.2823955	1949	3.2898118	1982	3.2971036
1917	3.2826221	1950	3.2900346	1983	3.2973227
1918	3.2828486	1951	3.2902573	1984	3.2975417
1919	3.2830750	1952	3.2904798	1985	3.2977605
1920	3.2833012	1953	3.2907022	1986	3.2979792
1921	3.2835274	1954	3.2909246	1987	3.2981979
1922	3.2837534	1955	3.2911468	1988	3.2984164
1923	3.2839793	1956	3.2913688	1989	3.2986348
1924	3.2842051	1957	3.2915908	1990	3.2988531
1925	3.2844307	1958	3.2918127	1991	3.2990713
1926	3.2846563	1959	3.2920344	1992	3.2992893
1927	3.2848817	1960	3.2922561	1993	3.2995073
1928	3.2851070	1961	3.2924776	1994	3.2997252
1929	3.2853322	1962	3.2926990	1995	3.2999429
1930	3.2855573	1963	3.2929203	1996	3.3001605
1931	3.2857823	1964	3.2931415	1997	3.3003781
1932	3.2860071	1965	3.2933626	1998	3.3005955
1933	3.2862319	1966	3.2935835	1999	3.3008128
1934	3.2864565	1967	3.2938044	2000	3.3010300

N.	*Logarith.*	*N.*	*Logarith.*	*N.*	*Logarith.*
2001	3.3012471	2034	3.3083509	2067	3.3153405
2002	3.3014641	2035	3.3085644	2068	3.3155505
2003	3.3016809	2036	3.3087778	2069	3.3157605
2004	3.3018977	2037	3.3089910	2070	3.3159703
2005	3.3021144	2038	3.3062042	2071	3.3161801
2006	3.3023309	2039	3.3094172	2072	3.3163897
2007	3.3025474	2040	3.3096302	2073	3.3165993
2008	3.3027637	2041	3.3098430	2074	3.3168087
2009	3.3029799	2042	3.3100557	2075	3.3170181
2010	3.3031961	2043	3.3102684	2076	3.3172273
2011	3.3034121	2044	3.3104809	2077	3.3174365
2012	3.3036280	2045	3.3106933	2078	3.3176455
2013	3.3038438	2046	3.3109056	2079	3.3178545
2014	3.3040595	2047	3.3111178	2080	3.3180633
2015	3.3042751	2048	3.3113299	2081	3.3182721
2016	3.3044905	2049	3.3115420	2082	3.3184807
2017	3.3047059	2050	3 3117539	2083	3.3186893
2018	3.3049212	2051	3.3119657	2084	3.3188977
2019	3.3051363	2052	3.3121774	2085	3.3191061
2020	3.3053514	2053	3.3123889	2086	3.3193143
2021	3.3055663	2054	3.3126004	2087	3.3195224
2022	3.3057812	2055	3.3128118	2088	3.3197305
2023	3.3059959	2056	3.3130231	2089	3.3199384
2024	3.3062105	2057	3.3132343	2090	3.3201463
2025	3.3064250	2058	3.3134454	2091	3.3203540
2026	3.3066394	2059	3.3136563	2092	3.3205617
2027	3.3068537	2060	3.3138672	2093	3.3207692
2028	3.3070679	2061	3.3140780	2094	3.3209767
2029	3.3072820	2062	3.3142887	2095	3.3211840
2030	3.3074960	2063	3.3144992	2096	3.3213913
2031	3.3077099	2064	3.3147097	2097	3.3215984
2032	3.3079237	2065	3.3149200	2098	3.3218055
2033	3.3081374	2066	3.3151303	2099	3.3220124
2034	3.3083509	2067	3.3153405	2100	3.3222193

N.	Logarith.	N.	Logarith.	N.	Logarith.
2101	3.3224260	2134	3.3291944	2167	3.3358589
2102	3.3226327	2135	3.3293979	2168	3.3360593
2103	3.3228393	2136	3.3296012	2169	3.3362596
2104	3.3230457	2137	3.3298045	2170	3.3364597
2105	3.3232521	2138	3.3300077	2171	3.3366598
2106	3.3234584	2139	3.3302108	2172	3.3368598
2107	3.3236645	2140	3.3304138	2173	3.3370597
2108	3.3238706	2141	3.3306167	2174	3.3372595
2109	3.3240766	2142	3.3308195	2175	3.3374593
2110	3.3242825	2143	3.3310222	2176	3.3376589
2111	3.3244882	2144	3.3312248	2177	3.3378584
2112	3.3246939	2145	3.3314273	2178	3.3380579
2113	3.3248995	2146	3.3316297	2179	3.3382572
2114	3.3251050	2147	3.3318320	2180	3.3384565
2115	3.3253104	2148	3.3320343	2181	3.3386557
2116	3.3255157	2149	3.3322364	2182	3.3388547
2117	3.3257209	2150	3.3324385	2183	3.3390537
2118	3.3259260	2151	3.3326404	2184	3.3392526
2119	3.3261310	2152	3.3328423	2185	3.3394514
2120	3.3263359	2153	3.3330440	2186	3.3396502
2121	3.3265407	2154	3.3332457	2187	3.3398488
2122	3.3267454	2155	3.3334473	2188	3.3400473
2123	3.3269500	2156	3.3336488	2189	3.3402458
2124	3.3271545	2157	3.3338501	2190	3.3404441
2125	3.3273589	2158	3.3340514	2191	3.3406424
2126	3.3275633	2159	3.3342526	2192	3.3408405
2127	3.3277675	2160	3.3344537	2193	3.3410386
2128	3.3279716	2161	3.3346548	2194	3.3412366
2129	3.3281757	2162	3.3348557	2195	3.3414345
2130	3.3283796	2163	3.3350565	2196	3.3416323
2131	3.3285834	2164	3.3352573	2197	3.3418301
2132	3.3287872	2165	3.3354579	2198	3.3420277
2133	3.3289909	2166	3.3356585	2199	3.3422252
2134	3.3291944	2167	3.3358589	2200	3.3424227

N.	Logarith.	N.	Logarith.	N.	Logarith.
2201	3.3426200	2234	3.3490832	2267	3.3554515
2202	3.3428173	2235	3.3492775	2268	3.3556430
2203	3.3430145	2236	3.3494718	2269	3.3558345
2204	3.3432116	2237	3.3496660	2270	3.3560259
2205	3.3434086	2238	3.3498601	2271	3.3562171
2206	3.3436055	2239	3.3500541	2272	3.3564083
2207	3.3438023	2240	3.3502480	2273	3.3565994
2208	3.3439991	2241	3.3504419	2274	3.3567905
2209	3.3441957	2242	3.3506356	2275	3.3569814
2210	3.3443923	2243	3.3508293	2276	3.3571723
2211	3.3445887	2244	3.3510228	2277	3.3573630
2212	3.3447851	2245	3.3512163	2278	3.3575537
2213	3.3449814	2246	3.3514098	2279	3.3577443
2214	3.3451776	2247	3.3516031	2280	3.3579348
2215	3.3453737	2248	3.3517963	2281	3.3581253
2216	3.3455698	2249	3.3519895	2282	3.3583156
2217	3.3457657	2250	3.3521825	2283	3.3585059
2218	3.3459615	2251	3.3523755	2284	3.3586961
2219	3.3461573	2252	3.3525684	2285	3.3588862
2220	3.3463530	2253	3.3527612	2286	3.3590762
2221	3.3465486	2254	3.3529539	2287	3.3592662
2222	3.3467441	2255	3.3531465	2288	3.3594560
2223	3.3469395	2256	3.3533391	2289	3.3596458
2224	3.3471348	2257	3.3535316	2290	3.3598355
2225	3.3473300	2258	3.3537239	2291	3.3600251
2226	3.3475252	2259	3.3539162	2292	3.3602146
2227	3.3477202	2260	3.3541084	2293	3.3604041
2228	3.3479152	2261	3.3543006	2294	3.3605934
2229	3.3481101	2262	3.3544926	2295	3.3607827
2230	3.3483049	2263	3.3546846	2296	3.3609719
2231	3.3484996	2264	3.3548764	2297	3.3611610
2232	3.3486942	2265	3.3550682	2298	3.3613500
2233	3.3488887	2266	3.3552599	2299	3.3615390
2234	3.3490832	2267	3.3554515	2300	3.3617278

N.	Logarith.	N.	Logarith.	N.	Logarith
2301	3.3619166	2334	3.3681008	2367	3.3741983
2302	3.3621053	2335	3.3682869	2368	3.3743817
2303	3.3622939	2336	3.3684728	2369	3.3745651
2304	3.3624825	2337	3.3686587	2370	3.3747483
2305	3.3626709	2338	3.3688445	2371	3.3749316
2306	3.3628593	2339	3.3690302	2372	3.3751147
2307	3.3630476	2340	3.3692159	2373	3.3752977
2308	3.3632358	2341	3.3694014	2374	3.3754807
2309	3.3634239	2342	3.3695869	2375	3.3756636
2310	3.3636120	2343	3.3697723	2376	3.3758464
2311	3.3637999	2344	3.3699576	2377	3.3760292
2312	3.3639878	2345	3.3701428	2378	3.3762118
2313	3.3641756	2346	3.3703280	2379	3.3763944
2314	3.3643634	2347	3.3705131	2380	3.3765770
2315	3.3645510	2348	3.3706981	2381	3.3767594
2316	3.3647386	2349	3.3708830	2382	3.3769418
2317	3.3649260	2350	3.3710679	2383	3.3771240
2318	3.3651134	2351	3.3712526	2384	3.3773062
2319	3.3653007	2352	3.3714373	2385	3.3774884
2320	3.3654880	2353	3.3716219	2386	3.3776704
2321	3.3656751	2354	3.3718065	2387	3.3778524
2322	3.3658622	2355	3.3719909	2388	3.3780343
2323	3.3660492	2356	3.3721753	2389	3.3782161
2324	3.3662361	2357	3.3723596	2390	3.3783979
2325	3.3664230	2358	3.3725438	2391	3.3785796
2326	3.3666097	2359	3.3727279	2392	3.3787612
2327	3.3667964	2360	3.3729120	2393	3.3789427
2328	3.3669830	2361	3.3730960	2394	3.3791241
2329	3.3671695	2362	3.3732799	2395	3.3793055
2330	3.3673559	2363	3.3734637	2396	3.3794868
2331	3.3675423	2364	3.3736475	2397	3.3796680
2332	3.3677285	2365	3.3738311	2398	3.3798492
2333	3.3679147	2366	3.3740147	2399	3.3800302
2334	3.3681008	2367	3.3741983	2400	3.3802112

N.	Logarith.	N.	Logarith.	N.	Logarith.
2401	3.3803922	2434	3.3863206	2467	3.3921691
2402	3.3805730	2435	3.3864990	2468	3.3923452
2403	3.3807538	2436	3.3866773	2469	3.3925211
2404	3.3809345	2437	3.3868555	2470	3.3926970
2405	3.3811151	2438	3.3870337	2471	3.3928727
2406	3.3812956	2439	3.3872118	2472	3.3930485
2407	3.3814761	2440	3.3873898	2473	3.3932241
2408	3.3816565	2441	3.3875678	2474	3.3933997
2409	3.3818368	2442	3.3877457	2475	3.3935752
2410	3.3820170	2443	3.3879235	2476	3.3937506
2411	3.3821972	2444	3.3881012	2477	3.3939260
2412	3.3823773	2445	3.3882789	2478	3.3941013
2413	3.3825573	2446	3.3884565	2479	3.3942765
2414	3.3827373	2447	3.3886340	2480	3.3944517
2415	3.3829171	2448	3.3888114	2481	3.3946268
2416	3.3830969	2449	3.3889888	2482	3.3948018
2417	3.3832766	2450	3.3891661	2483	3.3949767
2418	3.3834563	2451	3.3893433	2484	3.3951516
2419	3.3836359	2452	3.3895205	2485	3.3953264
2420	3.3838154	2453	3.3896975	2486	3.3955011
2421	3.3839948	2454	3.3898746	2487	3.3956758
2422	3.3841741	2455	3.3900515	2488	3.3958504
2423	3.3843534	2456	3.3902284	2489	3.3960249
2424	3.3845326	2457	3.3904052	2490	3.3961993
2425	3.3847117	2458	3.3905819	2491	3.3963737
2426	3.3848908	2459	3.3907585	2492	3.3965480
2427	3.3850698	2460	3.3909351	2493	3.3967223
2428	3.3852487	2461	3.3911116	2494	3.3968964
2429	3.3854275	2462	3.3912880	2495	3.3970705
2430	3.3856063	2463	3.3914644	2496	3.3972446
2431	3.3857850	2464	3.3916407	2497	3.3974185
2432	3.3859636	2465	3.3918169	2498	3.3975924
2433	3.3861421	2466	3.3919931	2499	3.3977663
2434	3.3863206	2467	3.3921691	2500	3.3979400

N.	Logarith.	N.	Logarith.	N.	Logarith.
2501	3.3981137	2534	3.4038066	2567	3.4094259
2502	3.3982873	2535	3.4039780	2568	3.4095950
2503	3.3984608	2536	3.4041492	2569	3.4097641
2504	3.3986343	2537	3.4043205	2570	3.4099331
2505	3.3988077	2538	3.4044916	2571	3.4101021
2506	3.3989811	2539	3.4046627	2572	3.4102710
2507	3.3991543	2540	3.4048337	2573	3.4104398
2508	3.3993275	2541	3.4050047	2574	3.4106085
2509	3.3995007	2542	3.4051755	2575	3.4107772
2510	3.3996737	2543	3.4053464	2576	3.4109459
2511	3.3998467	2544	3.4055171	2577	3.4111144
2512	3.4000196	2545	3.4056878	2578	3.4112829
2513	3.4001925	2546	3.4058584	2579	3.4114513
2514	3.4003653	2547	3.4060289	2580	3.4116197
2515	3.4005380	2548	3.4061994	2581	3.4117880
2516	3.4007106	2549	3.4063698	2582	3.4119562
2517	3.4008832	2550	3.4065402	2583	3.4121244
2518	3.4010557	2551	3.4067105	2584	3.4122925
2519	3.4012282	2552	3.4068807	2585	3.4124605
2520	3.4014005	2553	3.4070508	2586	3.4126285
2521	3.4015728	2554	3.4072209	2587	3.4127964
2522	3.4017451	2555	3.4073909	2588	3.4129643
2523	3.4019173	2556	3.4075608	2589	3.4131320
2524	3.4020893	2557	3.4077307	2590	3.4132998
2525	3.4022614	2558	3.4079005	2591	3.4134674
2526	3.4024333	2559	3.4080703	2592	3.4136350
2527	3.4026052	2560	3.4082400	2593	3.4138025
2528	3.4027771	2561	3.4084096	2594	3.4139700
2529	3.4029488	2562	3.4085791	2595	3.4141374
2530	3.4031205	2563	3.4087486	2596	3.4143047
2531	3.4032921	2564	3.4089180	2597	3.4144719
2532	3.4034637	2565	3.4090874	2598	3.4146391
2533	3.4036352	2566	3.4092567	2599	3.4148063
2534	3.4038066	2567	3.4094259	2600	3.4149733

N.	Logarith.	N.	Logarith.	N.	Logarith.
2601	3.4151404	2634	3.4206158	2667	3.4260230
2602	3.4153073	2635	3.4207806	2668	3.4261858
2603	3.4154742	2636	3.4209454	2669	3.4263486
2604	3.4156410	2637	3.4211101	2670	3.4265113
2605	3.4158077	2638	3.4212748	2671	3.4266739
2606	3.4159744	2639	3.4214394	2672	3.4268365
2607	3.4161410	2640	3.4216039	2673	3.4269990
2608	3.4163076	2641	3.4217684	2674	3.4271614
2609	3.4164741	2642	3.4219328	2675	3.4273238
2610	3.4166405	2643	3.4220972	2676	3.4274861
2611	3.4168069	2644	3.4222614	2677	3.4276484
2612	3.4169732	2645	3.4224257	2678	3.4278106
2613	3.4171394	2646	3.4225898	2679	3.4279727
2614	3.4173056	2647	3.4227539	2680	3.4281348
2615	3.4174717	2648	3.4229180	2681	3.4282968
2616	3.4176377	2649	3.4230820	2682	3.4284588
2617	3.4178037	2650	3.4232459	2683	3.4286207
2618	3.4179696	2651	3.4234097	2684	3.4287825
2619	3.4181355	2652	3.4235735	2685	3.4289443
2620	3.4183013	2653	3.4237372	2686	3.4291060
2621	3.4184670	2654	3.4239009	2687	3.4292677
2622	3.4186327	2655	3.4240645	2688	3.4294293
2623	3.4187983	2656	3.4242281	2689	3.4295908
2624	3.4189638	2657	3.4243916	2690	3.4297523
2625	3.4191293	2658	3.4245550	2691	3.4299137
2626	3.4192947	2659	3.4247183	2692	3.4300751
2627	3.4194601	2660	3.4248816	2693	3.4302364
2628	3.4196254	2661	3.4250449	2694	3.4303976
2629	3.4197906	2662	3.4252080	2695	3.4305588
2630	3.4199557	2663	3.4253712	2696	3.4307199
2631	3.4201208	2664	3.4255342	2697	3.4308809
2632	3.4202859	2665	3.4256972	2698	3.4310419
2633	3.4204509	2666	3.4258601	2599	3.4312029
2634	3.4206158	2667	3.4260230	2700	3.4313638

N.	Logarith.	N.	Logarith.	N.	Logarith.
2701	3.4315246	2734	3.4367985	2767	3.4420092
2702	3.4316853	2735	3.4369573	2768	3.4421661
2703	3.4318460	2736	3.4371161	2769	3.4423230
2704	3.4320067	2737	3.4372748	2770	3.4424798
2705	3.4321673	2738	3.4374334	2771	3.4426365
2706	3.4323278	2739	3.4375920	2772	3.4427932
2707	3.4324883	2740	3.4377506	2773	3.4429499
2708	3.4326487	2741	3.4379090	2774	3.4431065
2709	3.4328090	2742	3.4380674	2775	3.4432630
2710	3.4329693	2743	3.4382258	2776	3.4434195
2711	3.4331295	2744	3.4383841	2777	3.4435759
2712	3.4332897	2745	3.4385423	2778	3.4437322
2713	3.4334498	2746	3.4387005	2779	3.4438885
2714	3.4336098	2747	3.4388587	2780	3.4440448
2715	3.4337698	2748	3.4390167	2781	3.4442010
2716	3.4339298	2749	3.4391747	2782	3.4443571
2717	3.4340896	2750	3.4393327	2783	3.4445132
2718	3.4342494	2751	3.4394906	2784	3.4446692
2719	3.4344092	2752	3.4396484	2785	3.4448252
2720	3.4345689	2753	3.4398062	2786	3.4449811
2721	3.4347285	2754	3.4399639	2787	3.4451370
2722	3.4348881	2755	3.4401216	2788	3.4452928
2723	3.4350476	2756	3.4402792	2789	3.4454485
2724	3.4352071	2757	3.4404368	2790	3.4456042
2725	3.4353665	2758	3.4405943	2791	3.4457598
2726	3.4355258	2759	3.4407517	2792	3.4459154
2727	3.4356851	2760	3.4409091	2793	3.4460709
2728	3.4358444	2761	3.4410664	2794	3.4462264
2729	3.4360035	2762	3.4412237	2795	3.4463818
2730	3.4361626	2763	3.4413809	2796	3.4465372
2731	3.4363217	2764	3.4415380	2797	3.4466925
2732	3.4364807	2765	3.4416951	2798	3.4468477
2733	3.4366396	2766	3.4418522	2799	3.4470029
2734	3.4367985	2767	3.4420092	2800	3.4471580

N.	Logarith.	N.	Logarith.	N.	Logarith.
2801	3.4473131	2834	3.4523998	2867	3.4574277
2802	3.4474681	2835	3.4525531	2868	3.4575791
2803	3.4476231	2836	3.4527062	2869	3.4577305
2804	3.4477780	2837	3.4528593	2870	3.4578819
2805	3.4479329	2838	3.4530124	2871	3.4580332
2806	3.4480877	2839	3.4531654	2872	3.4581844
2807	3.4482424	2840	3.4533183	2873	3.4583356
2808	3.4483971	2841	3.4534712	2874	3.4584868
2809	3.4485517	2842	3.4536241	2875	3.4586378
2810	3.4487063	2843	3.4537769	2876	3.4587889
2811	3.4488608	2844	3.4539296	2877	3.4589399
2812	3.4490153	2845	3.4540823	2878	3.4590908
2813	3.4491697	2846	3.4542349	2879	3.4592417
2814	3.4493241	2847	3.4543875	2880	3.4593925
2815	3.4494784	2848	3.4545400	2881	3.4595433
2816	3.4496326	2849	3.4546924	2882	3.4596940
2817	3.4497868	2850	3.4548449	2883	3.4598446
2818	3.4499410	2851	3.4549972	2884	3.4599953
2819	3.4500951	2852	3.4551495	2885	3.4601458
2820	3.4502491	2853	3.4553018	2886	3.4602963
2821	3.4504031	2854	3.4554540	2887	3.4604468
2822	3.4505570	2855	3.4556061	2888	3.4605972
2823	3.4507109	2856	3.4557582	2889	3.4607475
2824	3.4508647	2857	3.4559102	2890	3.4608978
2825	3.4510184	2858	3.4560622	2891	3.4610481
2826	3.4511722	2859	3.4562142	2892	3.4611983
2827	3.4513258	2860	3.4563660	2893	3.4613484
2828	3.4514794	2861	3.4565179	2894	3.4614985
2829	3.4516329	2862	3.4566696	2895	3.4616486
2830	3.4517864	2863	3.4568213	2896	3.4617986
2831	3.4519399	2864	3.4569730	2897	3.4619485
2832	3.4520932	2865	3.4571246	2898	3.4620984
2833	3.4522466	2866	3.4572762	2899	3.4622482
2834	3.4523998	2867	3.4574277	2900	3.4623980

N.	Logarith.	N.	Logarith.	N.	Logarith
2901	3.4625477	2934	3.4674601	2967	3.4723175
2902	3.4626974	2935	3.4676081	2968	3.4724639
2903	3.4628470	2936	3.4677560	2969	3.4726102
2904	3.4629966	2937	3.4679039	2970	3.4727564
2905	3.4631461	2938	3.4680518	2971	3.4729027
2906	3.4632956	2939	3.4681996	2972	3.4730488
2907	3.4634450	2940	3.4683473	2973	3.4731949
2908	3.4635944	2941	3.4684950	2974	3.4733410
2909	3.4637437	2942	3.4686427	2975	3.4734870
2910	3.4638930	2943	3.4687903	2976	3.4736329
2911	3.4640422	2944	3.4689378	2977	3.4737788
2912	3.4641914	2945	3.4690853	2978	3.4739247
2913	3.4643405	2946	3.4692327	2979	3.4740705
2914	3.4644895	2947	3.4693801	2980	3.4742163
2915	3.4646386	2948	3.4695275	2981	3.4743620
2916	3.4647875	2949	3.4696748	2982	3.4745076
2917	3.4649364	2950	3.4698220	2983	3.4746533
2918	3.4650853	2951	3.4699692	2984	3.4747988
2919	3.4652341	2952	3.4701163	2985	3.4749443
2920	3.4653828	2953	3.4702634	2986	3.4750898
2921	3.4655316	2954	3.4704105	2987	3.4752352
2922	3.4656802	2955	3.4705575	2988	3.4753806
2923	3.4658288	2956	3.4707044	2989	3.4755259
2924	3.4659774	2957	3.4708513	2990	3.4756712
2925	3.4661259	2958	3.4709982	2991	3.4758164
2926	3.4662743	2959	3.4711450	2992	3.4759616
2927	3.4664227	2960	3.4712917	2993	3.4761067
2928	3.4665711	2961	3.4714384	2994	3.4762518
2929	3.4667194	2962	3.4715851	2995	3.4763968
2930	3.4668676	2963	3 4717317	2996	3.4765418
2931	3.4670158	2964	3.4718782	2997	3.4766867
2932	3.4671640	2965	3.4720247	2998	3.4768316
2933	3.4673121	2966	3.4721711	2999	3.4769765
2934	3.4674601	2967	3.4723175	3000	3.4771213

N.	Logarith.	N.	Logarith.	N.	Logarith.
3001	3.4772660	3034	3.4820156	3067	3.4867138
3002	3.4774107	3035	3.4821587	3068	3.4868554
3003	3.4775553	3036	3.4823018	3069	3.4869969
3004	3.4776999	3037	3.4824448	3070	3.4871384
3005	3.4778445	3038	3.4825878	3071	3.4872798
3006	3.4779890	3039	3.4827307	3072	3.4874212
3007	3.4781334	3040	3.4828736	3073	3.4875626
3008	3.4782778	3041	3.4830164	3074	3.4877039
3009	3.4784222	3042	3.4831592	3075	3.4878451
3010	3.4785665	3043	3.4833019	3076	3.4879863
3011	3.4787108	3044	3.4834446	3077	3.4881275
3012	3.4788550	3045	3.4835873	3078	3.4882686
3013	3.4789991	3046	3.4837299	3079	3.4884097
3014	3.4791432	3047	3.4838725	3080	3.4885507
3015	3.4792873	3048	3.4840150	3081	3.4886917
3016	3.4794313	3049	3.4841574	3082	3.4888326
3017	3.4795753	3050	3.4842998	3083	3.4889735
3018	3.4797192	3051	3.4844422	3084	3.4891144
3019	3.4798631	3052	3.4845845	3085	3.4892552
3020	3.4800069	3053	3.4847268	3086	3.4893959
3021	3.4801507	3054	3.4848690	3087	3.4895366
3022	3.4802945	3055	3.4850112	3088	3.4896773
3023	3.4804381	3056	3.4851533	3089	3.4898179
3024	3.4805818	3057	3.4852954	3090	3.4899585
3025	3.4807254	3058	3.4854375	3091	3.4900990
3026	3.4808689	3059	3.4855795	3092	3.4902395
3027	3.4810124	3060	3.4857214	3093	3.4903799
3028	3.4811559	3061	3.4858633	3094	3.4905203
3029	3.4812993	3062	3.4860052	3095	3.4906607
3030	3.4814426	3063	3.4861470	3096	3.4908009
3031	3.4815859	3064	3.4862888	3097	3.4909412
3032	3.4817292	3065	3.4864305	3098	3.4910814
3033	3.4818724	3066	3.4865721	3099	3.4912216
3034	3.4820156	3067	3.4867138	3100	3.4913617

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3101	3.4915018
3102	3.4916418
3103	3.4917818
3104	3.4919217
3105	3.4920616
3106	3.4922014
3107	3.4923413
3108	3.4924810
3109	3.4926207
3110	3.4927604
3111	3.4929000
3112	3.4930396
3113	3.4931791
3114	3.4933186
3115	3.4934580
3116	3.4935974
3117	3.4937368
3118	3.4938761
3119	3.4940154
3120	3.4941546
3121	3.4942938
3122	3.4944329
3123	3.4945720
3124	3.4947110
3125	3.4948500
3126	3.4949890
3127	3.4951279
3128	3.4952667
3129	3.4954056
3130	3.4955443
3131	3.4956831
3132	3.4958218
3133	3.4959604
3134	3.4960990
3134	3.4960990
3135	3.4962375
3136	3.4963761
3137	3.4965145
3138	3.4966529
3139	3.4967913
3140	3.4969296
3141	3.4970679
3142	3.4972062
3143	3.4973444
3144	3.4974825
3145	3.4976206
3146	3.4977587
3147	3.4978967
3148	3.4980347
3149	3.4981727
3150	3.4983106
3151	3.4984484
3152	3.4985862
3153	3.4987240
3154	3.4988617
3155	3.4989994
3156	3.4991370
3157	3.4992746
3158	3.4994121
3159	3.4995496
3160	3.4996871
3161	3.4998245
3162	3.4999619
3163	3.5000992
3164	3.5002365
3165	3.5003737
3166	3.5005109
3167	3.5006481
3167	3.5006481
3168	3.5007852
3169	3.5009222
3170	3.5010593
3171	3.5011962
3172	3.5013332
3173	3.5014701
3174	3.5016069
3175	3.5017437
3176	3.5018805
3177	3.5020172
3178	3.5021539
3179	3.5022905
3180	3.5024271
3181	3.5025637
3182	3.5027002
3183	3.5028366
3184	3.5029731
3185	3.5031094
3186	3.5032458
3187	3.5033821
3188	3.5035183
3189	3.5036545
3190	3.5037907
3191	3.5039268
3192	3.5040629
3193	3.5041989
3194	3.5043349
3195	3.5044709
3196	3.5046068
3197	3.5047426
3198	3.5048785
3199	3.5050142
3200	3.5051500

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3201	3.5052857	3234	3.5097400	3267	3.5141491
3202	3.5054213	3235	3.5098743	3268	3.5142820
3203	3.5055569	3236	3.5100085	3269	3.5144149
3204	3.5056925	3237	3.5101427	3270	3.5145478
3205	3.5058280	3238	3.5102768	3271	3.5146805
3206	3.5059635	3239	3.5104109	3272	3.5148133
3207	3.5060990	3240	3.5105450	3273	3.5149460
3208	3.5062344	3241	3.5106790	3274	3.5150787
3209	3.5063697	3242	3.5108130	3275	3.5152113
3210	3.5065050	3243	3.5109469	3276	3.5153439
3211	3.5066403	3244	3.5110808	3277	3.5154764
3212	3.5067755	3245	3.5112147	3278	3.5156089
3213	3.5069107	3246	3.5113485	3279	3.5157414
3214	3.5070459	3247	3.5114823	3280	3.5158738
3215	3.5071810	3248	3.5116160	3281	3.5160062
3216	3.5073160	3249	3.5117497	3282	3.5161386
3217	3.5074511	3250	3.5118834	3283	3.5162709
3218	3.5075860	3251	3.5120170	3284	3.5164031
3219	3.5077210	3252	3.5121505	3285	3.5165354
3220	3.5078559	3253	3.5122841	3286	3.5166676
3221	3.5079907	3254	3.5124175	3287	3.5167997
3222	3.5081255	3255	3.5125510	3288	3.5169318
3223	3.5082603	3256	3.5126844	3289	3.5170639
3224	3.5083950	3257	3.5128178	3290	3.5171959
3225	3.5085297	3258	3.5129511	3291	3.517[illegible]279
3226	3.5086644	3259	3.5130844	3292	3.5174598
3227	3.5087990	3260	3.5132176	3293	3.5175917
3228	3.5089335	3261	3.5133508	3294	3.5177236
3229	3.5090680	3262	3.5134840	3295	3.5178554
3230	3.5092025	3263	3.5136171	3296	3.5179872
3231	3.5093370	3264	3.5137501	3297	3.5181189
3232	3.5094713	3265	3.5138832	3298	3.5182506
3233	3.5096057	3266	3.5140162	3299	3.5183823
3234	3.5097400	3267	3.5141491	3300	3.5185139

N.	Logarith.	N.	Logarith.	N.	Logarith.
3301	3.5186455	3334	3.5229656	3367	3.5272431
3302	3.5187771	3335	3.5230958	3368	3.5273721
3303	3.5189086	3336	3.5232260	3369	3.5275010
3304	3.5190400	3337	3.5233562	3370	3.5276299
3305	3.5191715	3338	3.5234863	3371	3.5277588
3306	3.5193028	3339	3.5236164	3372	3.5278876
3307	3.5194342	3340	3.5237465	3373	3.5280163
3308	3.5195655	3341	3.5238765	3374	3.5281451
3309	3.5196968	3342	3.5240064	3375	3.5282738
3310	3.5198280	3343	3.5241364	3376	3.5284024
3311	3.5199592	3344	3.5242663	3377	3.5285311
3312	3.5200903	3345	3.5243961	3378	3.5286596
3313	3.5202214	3346	3.5245259	3379	3.5287882
3314	3.5203525	3347	3.5246557	3380	3.5289167
3315	3.5204835	3348	3.5247854	3381	3.5290452
3316	3.5206145	3349	3.5249151	3382	3.5291736
3317	3.5207455	3350	3.5250448	3383	3.5293020
3318	3.5208764	3351	3.5251744	3384	3.5294304
3319	3.5210073	3352	3.5253040	3385	3.5295587
3320	3.5211381	3353	3.5254336	3386	3.5296870
3321	3.5212689	3354	3.5255631	3387	3.5298152
3322	3.5213996	3355	3.5256925	3388	3.5299434
3323	3.5215303	3356	3.5258219	3389	3.5300716
3324	3.5216610	3357	3.5259513	3390	3.5301997
3325	3.5217916	3358	3.5260807	3391	3.5303278
3326	3.5219222	3359	3.5262100	3392	3.5304558
3327	3.5220528	3360	3.5263393	3393	3.5305839
3328	3.5221833	3361	3.5264685	3394	3.5307118
3329	3.5223138	3362	3.5265977	3395	3.5308398
3330	3.5224442	3363	3.5267269	3396	3.5309677
3331	3.5225746	3364	3.5268560	3397	3.5310955
3332	3.5227050	3365	3.5269851	3398	3.5312234
3333	3.5228353	3366	3.5271141	3399	3.5313512
3334	3.5229656	3367	3.5272431	3400	3.5314789

N.	Logarith.	N.	Logarith.	N.	Logarith.
3401	3.5316066	3434	3.5358003	3467	3.5399538
3402	3.5317343	3435	3.5359267	3468	3.5400791
3403	3.5318619	3436	3.5360532	3469	3.5402043
3404	3.5319895	3437	3.5361795	3470	3.5403295
3405	3.5321171	3438	3.5363059	3471	3.5404546
3406	3.5322446	3439	3.5364322	3472	3.5405797
3407	3.5323721	3440	3.5365584	3473	3.5407048
3408	3.5324996	3441	3.5366847	3474	3.5408298
3409	3.5326270	3442	3.5368109	3475	3.5409548
3410	3.5327544	3443	3.5369370	3476	3.5410798
3411	3.5328817	3444	3.5370631	3477	3.5412047
3412	3.5330090	3445	3.5371892	3478	3.5413296
3413	3.5331363	3446	3.5373153	3479	3.5414544
3414	3.5332635	3447	3.5374413	3480	3.5415792
3415	3.5333907	3448	3.5375673	3481	3.5417040
3416	3.5335179	3449	3.5376932	3482	3.5418288
3417	3.5336450	3450	3.5378191	3483	3.5419535
3418	3.5337721	3451	3.5379450	3484	3.5420781
3419	3.5338991	3452	3.5380708	3485	3.5422028
3420	3.5340261	3453	3.5381966	3486	3.5423274
3421	3.5341531	3454	3.5383223	3487	3.5424519
3422	3.5342800	3455	3.5384481	3488	3.5425765
3423	3.5344069	3456	3.5385737	3489	3.5427010
3424	3.5345338	3457	3.5386994	3490	3.5428254
3425	3.5346606	3458	3.5388250	3491	3.5429498
3426	3.5347874	3459	3.5389506	3492	3.5430742
3427	3.5349141	3460	3.5390761	3493	3.5431986
3428	3.5350408	3461	3.5392016	3494	3.5433229
3429	3.5351675	3462	3.5393271	3495	3.5434472
3430	3.5352941	3463	3.5394525	3496	3.5435714
3431	3.5354207	3464	3.5395779	3497	3.5436956
3432	3.5355473	3465	3.5397032	3498	3.5438198
3433	3.5356738	3469	3.5398286	3499	3.5439439
3434	3.5358003	3467	3.5399538	3500	3.5440680

N.	Logarith.	N.	Logarith.	N.	Logarith.
3501	3.5441921	3534	3.5482665	3567	3.5523031
3502	3.5443161	3535	3.5483894	3568	3.5524248
350	3.5444401	3536	3.5485123	3569	3.5525465
3504	3.5445641	3537	3.5486351	3570	3.5526682
3505	3.5446880	3538	3.5487578	3571	3.5527898
3506	3.5448119	3539	3.5488806	3572	3.5529114
3507	3.5449358	3540	3.5490033	3573	3.5530330
3508	3.5450596	3541	3.5491259	3574	3.5531545
3509	3.5451834	3542	3.5492486	3575	3.5532760
3510	3.5453071	3543	3.5493712	3576	3.5533975
3511	3.5454308	3544	3.5494937	3577	3.5535189
3512	3.5455545	3545	3.5496162	3578	3.5536403
3513	3.5456781	3546	3.5497387	3579	3.5537617
3514	3.5458018	3547	3.5498612	3580	3.5538830
3515	3.5459253	3548	3.5499836	3581	3.5540043
3516	3.5460489	3549	3.5501060	3582	3.5541256
3517	3.5461724	3550	3.5502284	3583	3.5542468
3518	3.5462958	3551	3.5503507	3584	3.5543680
3519	3.5464193	3552	3.5504730	3585	3.5544892
3520	3.5465427	3553	3.5505952	3586	3.5546103
3521	3.5466660	3554	3.5507174	3587	3.5547314
3522	3.5467894	3555	3.5508396	3588	3.5548524
3523	3.5469126	3556	3.5509618	3589	3.5549735
3524	3.5470359	3557	3.5510839	3590	3.5550944
3525	3.5471591	3558	3.5512059	3591	3.5552154
3526	3.5472823	3559	3.5513280	3592	3.5553363
3527	3.5474055	3560	3.5514500	3593	3.5554572
3528	3.5475286	3561	3.5515720	3594	3.5555781
3529	3.5476517	3562	3.5516939	3595	3.5556989
3530	3.5477747	3563	3.5518158	3596	3.5558197
3531	3.5478977	3564	3.5519377	3597	3.5559404
3532	3.5480207	3565	3.5520595	3598	3.5560612
3533	3.5481436	3566	3.5521813	3599	3.5561818
3534	3.5482665	3567	3.5523031	3600	3.5563025

N.	*Logarith.*	N.	*Logarith.*	N.	*Logvrith.*
3601	3.5564231	3634	3.5603849	3667	3.5643109
3602	3.5565437	3635	3.5605044	3668	3.5644293
3603	3.5566643	3636	3.5606239	3669	3.5645477
3604	3.5567848	3637	3.5607433	3670	3.5646661
3605	3.5569053	3638	3.5608627	3671	3.5647844
3606	3.5570257	3639	3.5609821	3672	3.5649027
3607	3.5571461	3640	3.5611014	3673	3.5650209
3608	3.5572665	3641	3.5612207	3674	3.5651392
3609	3.5573869	3642	3.5613399	3675	3.5652573
3610	3.5575072	3643	3.5614592	3676	3.5653755
3611	3.5576275	3644	3.5615784	3677	3.5654936
3612	3.5577477	3645	3.5616975	3678	3.5656117
3613	3.5578680	3646	3.5618167	3679	3.5657298
3614	3.5579881	3647	3.5619358	3680	3.5658478
3615	3.5581083	3648	3.5620548	3681	3.5659658
3616	3.5582284	3649	3.5621739	3682	3.5660838
3617	3.5583485	3650	3.5622929	3683	3.5662017
3618	3.5584686	3651	3.5624118	3684	3.5663196
3619	3.5585886	3652	3.5625308	3685	3.5664375
3620	3.5587086	3653	3.5626497	3686	3.5665553
3621	3.5588285	3654	3.5627685	3687	3.5666731
3622	3.5589484	3655	3.5628874	3688	3.5667909
3623	3.5590683	3656	3.5630062	3689	3.5669087
3624	3.5591882	3657	3.5631250	3690	3.5670264
3625	3.5593080	3658	3.5632437	3691	3.5671440
3626	3.5594278	3659	3.5633624	3692	3.5672617
3627	3.5595476	3660	3.5634811	3693	3.5673793
3628	3.5596673	3661	3.5635997	3694	3.5674969
3629	3.5597870	3662	3.5637183	3695	3.5676144
3630	3.5599066	3663	3.5638369	3696	3.5677320
3631	3.5600262	3664	3.5639555	3697	3.5678494
3632	3.5601458	3665	3.5640740	3698	3.5679669
3633	3.5602654	3666	3.5641925	3699	3.5680843
3634	3.5603849	3667	3.5643109	3700	3.5682017

N.	Logarith.	N.	Logarith.	N.	Logarith.
3701	3.5683191	3734	3.5721743	3767	3.5759959
3702	3.5684364	3735	3.5722906	3768	3.5761109
3703	3.5685537	3736	3.5724069	3769	3.5762261
3704	3.5686710	3737	3.5725231	3770	3.5763413
3705	3.5687882	3738	3.5726393	3771	3.5764565
3706	3.5689054	3739	3.5727555	3772	3.5765717
3707	3.5690226	3740	3.5728716	3773	3.5766868
3708	3.5691397	3741	3.5729877	3774	3.5768019
3709	3.5692568	3742	3.5731038	3775	3.5769170
3710	3.5693739	3743	3.5732198	3776	3.5770320
3711	3.5694910	3744	3.5733358	3777	3.5771470
3712	3.5696080	3745	3.5734518	3778	3.5772620
3713	3.5697249	3746	3.5735678	3779	3.5773769
3714	3.5698419	3747	3.5736837	3780	3.5774918
3715	3.5699588	3748	3.5737996	3781	3.5776067
3716	3.5700757	3749	3.5739154	3782	3.5777215
3717	3.5701926	3750	3.5740313	3783	3.5778363
3718	3.5703094	3751	3.5741471	3784	3.5779511
3719	3.5704262	3752	3.5742628	3785	3.5780659
3720	3.5705429	3753	3.5743786	3786	3.5781806
3721	3.5706597	3754	3.5744943	3787	3.5782953
3722	3.5707764	3755	3.5746099	3788	3.5784100
3723	3.5708930	3756	3.5747256	3789	3.5785246
3724	3.5710097	3757	3.5748412	3790	3.5786392
3725	3.5711263	3758	3.5749568	3791	3.5787538
3726	3.5712428	3759	3.5750723	3792	3.5788683
3727	3.5713594	3760	3.5751878	3793	3.5789828
3728	3.5714759	3761	3.5753033	3794	3.5790973
3729	3.5715924	3762	3.5754188	3795	3.5792118
3730	3.5717088	3763	3.5755342	3796	3.5793262
3731	3.5718252	3764	3.5756496	3797	3.5794406
3732	3.5719416	3765	3.5757650	3798	3.5795550
3733	3.5720580	3766	3.5758803	3799	3.5796693
3734	3.5721743	3767	3.5759956	3800	3.5797836

N.	Logarith.	N.	Logarith.	N.	Logarith.
3801	3.5798979	3834	3.5836521	3867	3.5873742
3802	3.5800121	3835	3.5837654	3868	3.5874865
3803	3.5801263	3836	3.5838786	3869	3.5875987
3804	3.5802405	3837	3.5839918	3870	3.5877110
3805	3.5803547	3838	3.5841050	3871	3.5878232
3806	3.5804688	3839	3.5842181	3872	3.5879353
3807	3.5805829	3840	3.5843312	3873	3.5880475
3808	3.5806969	3841	3.5844443	3874	3.5881596
3809	3.5808110	3842	3.5845574	3875	3.5882717
3810	3.5809250	3843	3.5846704	3876	3.5883838
3811	3.5810389	3844	3.5847834	3877	3.5884958
3812	3.5811529	3845	3.5848963	3878	3.5886078
3813	3.5812668	3846	3.5850093	3879	3.5887198
3814	3.5813807	3847	3.5851222	3880	3.5888317
3815	3.5814945	3848	3.5852351	3881	3.5889436
3816	3.5816084	3849	3.5853479	3882	3.5890555
3817	3.5817222	3850	3.5854607	3883	3.5891674
3818	3.5818359	3851	3.5855735	3884	3.5892792
3819	3.5819497	3452	3.5856863	3885	3.5893910
3820	3.5820634	3853	3.5857990	3886	3.5895028
3821	3.5821770	3854	3.5859117	3887	3.5896145
3822	3.5822907	3855	3.5860244	3888	3.5897263
3823	3.5824043	3856	3.5861370	3889	3.5898379
3824	3.5825179	3857	3.5862496	3890	3.5899496
3825	3.5826314	3858	3.5863622	3891	3.5900612
3826	3.5827450	3859	3.5864748	3892	3.5901728
3827	3.5828585	3860	3.5865873	3893	3.5902844
3828	3.5829719	3861	3.5866998	3894	3.5903959
3829	3.5830854	3862	3.5868123	3895	3.5905075
3830	3.5831988	3863	3.5869247	3896	3.5906189
3831	3.5833122	3864	3.5870371	3897	3.5907304
3832	3.5834255	3865	3.5871495	3898	3.5908418
3833	3.5835388	3866	3.5872618	3899	3.5909532
3834	3.5836521	3867	3.5873742	3900	3.5910646

N.	*Logarith.*	N.	*Logarith.*	N.	*Logarith.*
3901	3.5911759	3934	3.5948344	3967	3.5984622
3902	3.5912873	3935	3.5949447	3968	3.5985717
3903	3.5913986	3936	3.5950551	3969	3.5986811
3904	3.5915098	3937	3.5951654	3970	3.5987905
3905	3.5916210	3938	3.5952757	3971	3.5988999
3906	3.5917322	3939	3.5953860	3972	3.5990092
3907	3.5918434	3940	3.5954962	3973	3.5991186
3908	3.5919546	3941	3.5956064	3974	3.5992279
3909	3.5920657	3942	3.5957166	3975	3.5993371
3910	3.5921768	3943	3.5958268	3976	3.5994464
3911	3.5922878	3944	3.5959369	3977	3.5995556
3912	3.5923988	3945	3.5960470	3978	3.5996648
3913	3.5925098	3946	3.5961571	3979	3.5997739
3914	3.5926208	3947	3.5962671	3980	3.5998831
3915	3.5927318	3948	3.5963771	3981	3.5999922
3916	3.5928427	3949	3.5964871	3982	3.6001013
3917	3.5929536	3950	3.5965971	3983	3.6002103
3918	3.5930644	3951	3.5967070	3984	3.6003193
3919	3.5931753	3952	3.5968169	3985	3.6004283
3920	3.5932861	3953	3.5969268	3986	3.6005373
3921	3.5933968	3954	3.5970367	3987	3.6006462
3922	3.5935076	3955	3.5971465	3988	3.6007551
3923	3.5936183	3956	3.5972563	3989	3.6008640
3924	3.5937290	3957	3.5973660	3990	3.6009729
3925	3.5938397	3958	3.5974758	3991	3.6010817
3926	3.5939503	3959	3.5975855	3992	3.6011905
3927	3.5940609	3960	3.5976952	3993	3.6012993
3928	3.5941715	3961	3.5978048	3994	3.6014080
3929	3.5942820	3962	3.5979145	3395	3.6015168
3930	3.5943925	3963	3.5980241	3996	3.6016255
3931	3.5945030	3964	3.5981336	3997	3.6017341
3932	3.5946135	3965	3.5982432	3998	3.6018428
3933	3.5947239	3966	3.5983527	3999	3.6019514
3934	3.5948344	3967	3.5984622	4000	3.6020600

N.	Logarith.	N.	Logarith.	N.	Logarith.
4001	3.6021685	4034	3.6057359	4067	3.6092742
4002	3.6022771	4035	3.6058435	4068	3.6093809
4003	3.6023856	4036	3.6059512	4069	3.6094877
4004	3.6024941	4037	3.6060587	4070	3.6095944
4005	3.6026025	4038	3.6061663	4071	3.6097011
4006	3.6027109	4039	3.6062739	4072	3.6098078
4007	3.6028193	4040	3.6063814	4073	3.6099144
4008	3.6029277	4041	3.6064888	4074	3.6100210
4009	3.6030361	4042	3.6065963	4075	3.6101276
4010	3.6031444	4043	3.6067037	4076	3.6102342
4011	3.6032527	4044	3.6068111	4077	3.6103407
4012	3.6033609	4045	3.6069185	4078	3.6104472
4013	3.6034692	4046	3.6070259	4079	3.6105537
4014	3.6035774	4047	3.6071332	4080	3.6106602
4015	3.6036855	4048	3.6072405	4081	3.6107666
4016	3.6037937	4049	3.6073478	4082	3.6108730
4017	3.6039018	4050	3.6074550	4083	3.6109794
4018	3.6040099	4051	3.6075622	4084	3.6110857
4019	3.6041180	4052	3.6076694	4085	3.6111921
4020	3.6042261	4053	3.6077766	4086	3.6112984
4021	3.6043341	4054	3.6078837	4087	3.6114046
4022	3.6044421	4055	3.6079909	4088	3.6115109
4023	3.6045500	4056	3.6080979	4089	3.6116171
4024	3.6046580	4057	3 6082050	4090	3.6117233
4025	3.6047659	4058	3.6083120	4091	3.6118295
4026	3.6048738	4059	3.6084190	4092	3.6119356
4027	3.6049816	4060	3.6085260	4093	3.6120417
4028	3.6050895	4061	3.6086330	4094	3.6121478
4029	3.6051973	4062	3.6087399	4095	3.6122539
4030	3.6053050	4063	3.6088468	4096	3.6123599
4031	3.6054128	4064	3.6089537	4097	3.6124660
4032	3.6055205	4065	3.6090605	4098	3.6125720
4033	3.6056282	4066	3.6091674	4099	3.6126779
4034	3.6057359	4067	3.6092742	4100	3.6127839

N.	Logarith.	N.	Logarith.	N.	Logarith.
4101	3.6128898	4134	3.6163705	4167	3.6198235
4102	3.6129957	4135	3.6164755	4168	3.6199277
4103	3.6131015	4136	3.6165805	4169	3.6200319
4104	3.6132073	4137	3.6166855	4170	3.6201361
4105	3.6133132	4138	3.6167905	4171	3.6202402
4106	3.6134189	4139	3.6168954	4172	3.6203443
4107	3.6135247	4140	3.6170003	4173	3.6204484
4108	3.6136304	4141	3.6171052	4174	3.6205524
4109	3.6137361	4142	3.6172101	4175	3.6206565
4110	3.6138418	4143	3.6173149	4176	3.6207605
4111	3.6139475	4144	3.6174197	4177	3.6208645
4112	3.6140531	4145	3.6175245	4178	3.6209684
4113	3.6141587	4146	3.6176293	4179	3.6210724
4114	3.6142643	4147	3.6177340	4180	3.6211763
4115	3.6143698	4148	3.6178387	4181	3.6212802
4116	3.6144754	4149	3.6179434	4182	3.6213840
4117	3.6145809	4150	3.6180481	4183	3.6214879
4118	3.6146863	4151	3.6181527	4184	3.6215917
4119	3.6147918	4152	3.6182573	4185	3.6216955
4120	3.6148972	4153	3.6183619	4186	3.6217992
4121	3.6150026	4154	3.6184665	4187	3.6219030
4122	3.6151080	4155	3.6185710	4188	3.6220067
4123	3.6152133	4156	3.6186755	4189	3.6221104
4124	3.6153187	4157	3.6187800	4190	3.6222140
4125	3.6154240	4158	3.6188845	4191	3.6223177
4126	3.6155292	4159	3.6189889	4192	3.6224213
4127	3.6156345	4160	3.6190933	4193	3.6225249
4128	3.6157397	4161	3.6191977	4194	3.6226284
4129	3.6158449	4162	3.6193021	4195	3.6227320
4130	3.6159501	4163	3.6194064	4196	3.6228355
4131	3.6160552	4164	3.6195107	4197	3.6229390
4132	3.6161603	4165	3.6196150	4198	3.6230424
4133	3.6162654	4166	3.6197193	4199	3.6231459
4134	3.6163705	4167	3.6198235	4200	3.6232493

N.	Logarith.	N.	Logarith.	N.	Logarith.
4201	3.6233527	4234	3.6267509	4267	3.6301226
4202	3.6234560	4235	3.6268534	4268	3.6302244
4203	3.6235594	4236	3.6269559	4269	3.6303262
4204	3.6236627	4237	3.6270585	4270	3.6304279
4205	3.6237660	4238	3.6271610	4271	3.6305296
4206	3.6238693	4239	3.6272634	4272	3.6306312
4207	3.6239725	4240	3.6273659	4273	3.6307329
4208	3.6240757	4241	3.6274683	4274	3.6308345
4209	3.6241789	4242	3.6275707	4275	3.6309361
4210	3.6242821	4243	3.6276730	4276	3.6310377
4211	3.6243852	4244	3.6277754	4277	3.6311392
4212	3.6244884	4245	3.6278777	4278	3.6312408
4213	3.6245915	4246	3.6279800	4279	3.6313423
4214	3.6246945	4247	3.6280823	4280	3.6314438
4215	3.6247976	4248	3.6281845	4281	3.6315452
4216	3.6249006	4249	3.6282867	4282	3.6316467
4217	3.6250036	4250	3.6283889	4283	3.6317481
4218	3.6251066	4251	3.6284911	4284	3.6318495
4219	3.6252095	4252	3.6285933	4285	3 6319508
4220	3.6253124	4253	3.6286954	4286	3.6320522
4221	3.6254153	4254	3.6287975	4287	3.6321535
4222	3.6255182	4255	3.6288996	4288	3.6322548
4223	3.6256211	4256	3.6290016	4289	3.6323560
4224	3.6257239	4257	3.6291036	4290	3.6324573
4225	3.6258267	4258	3.6292057	4291	3.6325585
4226	3.6259295	4259	3.6293076	4292	3.6326597
4227	3.6260322	4260	3.6294096	4293	3.6327609
4228	3.6261350	4261	3.6295115	4294	3.6328620
4229	3.6262377	4262	3.6296134	4295	3.6329632
4230	3.6263404	4263	3.6297153	4296	3.6330643
4231	3.6264430	4264	3.6298172	4297	3.6331654
4232	3.6265457	4265	3.6299190	4298	3.6332664
4233	3.6266483	4266	3.6300208	4299	3.6333674
4234	3.6267509	4267	3.6301226	4300	3.6334685

N.	*Logarith.*	*N.*	*Logarith.*	*N.*	*Logarith.*
4301	3.6335694	4334	3.6368889	4367	3.6401832
4302	3.6336704	4335	3.6369891	4368	3.6402826
4303	3.6337713	4336	3.6370893	4369	3.6403820
4304	3.6338723	4337	3.6371894	4370	3.6404814
4305	3.6339732	4338	3.6372895	4371	3.6405808
4306	3.6340740	4339	3.6373896	4372	3.6406802
4307	3.6341749	4340	3.6374897	4373	3.6407795
4308	3.6342757	4341	3.6375898	4374	3.6408788
4309	3.6343765	4342	3.6376898	4375	3.6409781
4310	3.6344773	4343	3.6377898	4376	3.6410773
4311	3.6345780	4344	3.6378898	4377	3.6411765
4312	3.6346788	4345	3.6379898	4378	3.6412758
4313	3.6347795	4346	3.6380897	4379	3.6413749
4314	3.6348801	4347	3.6381896	4380	3.6414741
4315	3.6349808	4348	3.6382895	4381	3.6415733
4316	3.6350814	4349	3.6383894	4382	3.6416724
4317	3.6351820	4350	3.6384893	4383	3.6417715
4318	3.6352826	4351	3.6385891	4384	3.6418705
4319	3.6353832	4352	3.6386889	4385	3.6419696
4320	3.6354837	4353	3.6387887	4386	3.6420686
4321	3.6355843	4354	3.6388884	4387	3.6421676
4322	3.6356848	4355	3.6389882	4388	3.6422666
4323	3.6357852	4356	3.6390879	4389	3.6423656
4324	3.6358857	4357	3.6391876	4390	3.6424645
4325	3.6359861	4358	3.6392872	4391	3.6425634
4326	3.6360865	4359	3.6393869	4392	3.6426623
4327	3.6361869	4360	3.6394865	4393	3.6427612
4328	3.6362872	4361	3.6395861	4394	3.6428601
4329	3.6363876	4362	3.6396857	4395	3.6429589
4330	3.6364879	4363	3.6397852	4396	3.6430577
4331	3.6365882	4364	3.6398847	4397	3.6431565
4332	3.6366884	4365	3.6399842	4398	3.6432552
4333	3.6367887	4366	3.6400837	4399	3.6433540
4334	3.6368889	4367	3.6401832	4400	3.6434527

N.	Logarith.	N.	Logarith.	N.	Logarith.
4401	3.6435514	4434	3.6467957	4467	3.6500160
4402	3.6436500	4435	3.6468936	4468	3.6501132
4403	3.6437487	4436	3.6469915	4469	3.6502104
4404	3.6438473	4437	3.6470894	4470	3.6503075
4405	3.6439459	4438	3.6471873	4471	3.6504047
4406	3.6440445	4439	3.6472851	4472	3.6505018
4407	3.6441430	4440	3.6473830	4473	3.6505989
4408	3.6442416	4441	3.6474808	4474	3.6506960
4409	3.6443401	4442	3.6475786	4475	3.6507930
4410	3.6444386	4443	3.6476763	4476	3.6508901
4411	3.6445371	4444	3.6477740	4477	3.6509871
4412	3.6446355	4445	3.6478718	4478	3.6510841
4413	3.6447339	4446	3.6479695	4479	3.6511811
4414	3.6448323	4447	3.6480671	4480	3.6512780
4415	3.6449307	4448	3.6481648	4481	3.6513749
4416	3.6450291	4449	3.6482624	4482	3.6514719
4417	3.6451274	4450	3.6483600	4483	3.6515687
4418	3.6452257	4451	3.6484576	4484	3.6516656
4419	3.6453240	4452	3.6485552	4485	3.6517624
4420	3.6454223	4453	3.6486527	4486	3.6518593
4421	3.6455205	4454	3.6487502	4487	3.6519561
4422	3.6456187	4455	3.6488477	4488	3.6520528
4423	3.6457169	4456	3.6489452	4489	3.6521496
4424	3.6458151	4457	3.6490426	4490	3.6522463
4425	3.6459133	4458	3.6491401	4491	3.6523431
4426	3.6460114	4459	3.6492375	4492	3.6524397
4427	3.6461095	4460	3.6493349	4493	3.6525364
4428	3.6462076	4461	3.6494322	4494	3.6526331
4429	3.6463057	4462	3.6495296	4495	3.6527297
4430	3.6464037	4463	3.6496269	4496	3.6528263
4431	3.6465017	4464	3.6497242	4497	3.6529229
4432	3.6465997	4465	3.6498215	4498	3.6530195
4433	3.6466977	4466	3.6499187	4499	3.6531160
4434	3.6467957	4467	3.6500160	4500	3.6532125

N.	Logarith.	N.	Logarith.	N.	Logarith.
4501	3.6533090	4534	3.6564815	4567	3.6596310
4502	3.6534055	4535	3.6565773	4568	3.6597261
4503	3.6535019	4536	3.6566730	4569	3.6598212
4504	3.6535984	4537	3.6567688	4570	3.6599162
4505	3.6536948	4538	3.6568645	4571	3.6600112
4506	3.6537912	4539	3.6569602	4572	3.6601062
4507	3.6538876	4540	3.6570559	4573	3.6602012
4508	3.6539839	4541	3.6571515	4574	3.6602962
4509	3.6540802	4542	3.6572471	4575	3.6603911
4510	3.6541765	4543	3.6573427	4576	3.6604860
4511	3.6542728	4544	3.6574383	4577	3.6605809
4512	3.6543691	4545	3.6575339	4578	3.6606758
4513	3.6544653	4546	3.6576294	4579	3.6607706
4514	3.6545616	4547	3.6577250	4580	3.6608655
4515	3.6546578	4548	3.6578205	4581	3.6609603
4516	3.6547539	4549	3.6579159	4582	3.6610551
4517	3.6548501	4550	3.6580114	4583	3.6611499
4518	3.6549462	4551	3.6581068	4584	3.6612446
4519	3.6550423	4552	3.6582023	4585	3.6613393
4520	3.6551384	4553	3.6582976	4586	3.6614340
4521	3.6552345	4554	3.6583930	4587	3.6615287
4522	3.6553306	4555	3.6584884	4588	3.6616234
4523	3.6554266	4556	3.6585837	4589	3.6617181
4524	3.6555226	4557	3.6586790	4590	3.6618127
4525	3.6556186	4558	3.6587743	4591	3.6619073
4526	3.6557145	4559	3.6588696	4592	3.6620019
4527	3.6558105	4560	3.6589648	4593	3.6620964
4528	3.6559064	4561	3.6590601	4594	3.6621910
4529	3.6560023	4562	3.6591553	4595	3.6622855
4530	3.6560982	4563	3.6592505	4596	3.6623800
4531	3.6561941	4564	3.6593456	4597	3.6624745
4532	3.6562899	4565	3.6594408	4598	3.6625690
4533	3.6563857	4566	3.6595359	4599	3.6626634
4534	3.6564815	4567	3.6596310	4600	3.6627578

N.	*Logarith.*	N.	*Logarith.*	N.	*Logarith.*
4601	3.6628522	4634	3.6659560	4667	3.6690378
4602	3.6629466	4635	3.6660497	4668	3.6691308
4603	3 6630410	4636	3.6661434	4669	3.6692239
4604	3.6631353	4637	3.6662371	4670	3.6693169
4605	3.6632296	4638	3.6663307	4671	3.6694099
4606	3.6633239	4639	3.6664244	4672	3.6695028
4607	3.6634182	4640	3.6665180	4673	3.6695958
4608	3.6635125	4641	3.6666116	4674	3.6696887
4609	3.6636067	4642	3.6667051	4675	3.6697816
4610	3.6637009	4643	3.6667987	4676	3.6698745
4611	3.6637951	4644	3.6668922	4677	3.6699674
4612	3.6638893	4645	3.6669857	4678	3.6700602
4613	3.6639835	4646	3.6670792	4679	3.6701530
4614	3.6640776	4647	3.6671727	4680	3.6702459
4615	3.6641717	4648	3.6672661	4681	3.6703386
4616	3.6642658	4649	3.6673595	4682	3.6704314
4617	3.6643599	4650	3.6674530	4683	3.6705242
4618	3.6644539	4651	3.6675463	4684	3.6706169
4619	3.6645480	4652	3.6676397	4685	3.6707096
4620	3.6646420	4653	3.6677331	4686	3.0708023
4621	3.6647360	4654	3.6678264	4687	3.6708950
4622	3.6648299	4655	3.6679197	4688	3.6709876
4623	3.6649239	4656	3.6680130	4689	3.6710802
4624	3.6650178	4657	3.6681062	4690	3.6711728
4625	3.6651117	4658	3.6681995	4691	3.6712654
4626	3.6652056	4659	3.6682927	4692	3.6713580
4627	3.6652995	4660	3.6683859	4693	3.6714506
4628	3.6653933	4061	3.6684791	4694	3.6715431
4629	3.6654872	4662	3.6685723	4695	3.6716356
4630	3.6655810	4663	3.6686654	4696	3.6717281
4631	3.6656748	4664	3.6687585	4697	3.6718206
4632	3.6657686	4665	3.6688516	4698	3.6719130
4633	3.6658623	4666	3.6689447	4699	3.6720054
4634	3.6659560	4667	3.6690378	4700	3.6720979

N.	Logarith.	N.	Logarith.	N.	Logarith.
4701	3.6721903	4734	3.6752283	4767	3.6782452
4702	3.6722826	4735	3.6753200	4768	3.6783362
4703	3.6723750	4736	3.6754117	4769	3.6784273
4704	3.6724673	4737	3.6755034	4770	3.6785184
4705	3.6725596	4738	3.6755951	4771	3.6786094
4706	3.6726519	4739	3.6756867	4772	3.6787004
4707	3.6727442	4740	3.6757783	4773	3.6787914
4708	3.6728365	4741	3.6758700	4774	3.6788824
4709	3.6729287	4742	3.6759615	4775	3.6789734
4710	3.6730209	4743	3.6760531	4776	3.6790643
4711	3.6731131	4744	3.6761447	4777	3.6791552
4712	3.6732053	4745	3.6762362	4778	3.6792461
4713	3.6732974	4746	3.6763277	4779	3.6793370
4714	3.6733896	4747	3.6764192	4780	3.6794279
4715	3.6734817	4748	3.6765107	4781	3.6795187
4716	3.6735738	4749	3.6766022	4782	3.6796096
4717	3.6736659	4750	3.6766936	4783	3.6797004
4718	3.6737579	4751	3.6767850	4784	3.6797912
4719	3.6738500	4752	3.6768764	4785	3.6798819
4720	3.6739420	4753	3.6769678	4786	3.6799727
4721	3.6740340	4754	3.6770592	4787	3.6800634
4722	3.6741260	4755	3.6771505	4788	3.6801541
4723	3.6742179	4756	3.6772418	4789	3.6802448
4724	3.6743099	4757	3.6773332	4790	3.6803355
4725	3.6744018	4758	3.6774244	4791	3.6804262
4726	3.6744937	4759	3.6775157	4792	3.6805168
4727	3.6745856	4760	3.6776070	4793	3.6806074
4728	3.6746775	4761	3.6776982	4794	3.6806980
4729	3.6747693	4762	3.6777894	4795	3.6807886
4730	3.6748611	4763	3.6778806	4796	3.6808792
4731	3.6749529	4764	3.6779718	4797	3.6809697
4732	3.6750447	4765	3.6780629	4798	3.6810602
4733	3.6751365	4766	3.6781540	4799	3.6811507
4734	3.6752283	4767	3.6782452	4800	3.6812412

N.	*Logarith.*	*N.*	*Logarith.*	*N.*	*Logarith.*
4801	3.6813317	4834	3.6843066	4867	3.6872613
4802	3.6814222	4835	3.6843965	4868	3.6873506
4803	3.6815126	4836	3.6844863	4869	3.6874398
4804	3.6816030	4837	3.6845761	4870	3.6875290
4805	3.6816934	4838	3.6846659	4871	3.6876181
4806	3.6817838	4839	3.6847556	4872	3.6877073
4807	3.6818741	4840	3.6848454	4873	3.6877964
4808	3.6819645	4841	3.6849351	4874	3.6878855
4809	3.6820548	4842	3.6850248	4875	3.6879746
4810	3.6821451	4843	3.6851145	4876	3.6880637
4811	3.6822354	4844	3.6852041	4877	3.6881528
4812	3.6823256	4845	3.6852938	4878	3.6882418
4813	3.6824159	4846	3.6853834	4879	3.6883308
4814	3.6825061	4847	3.6854730	4880	3.6884198
4815	3.6825963	4848	3.6855626	4881	3.6885088
4816	3.6826865	4849	3.6856522	4882	3.6885978
4817	3.6827766	4850	3.6857417	4883	3.6886867
4818	3.6828668	4851	3.6858313	4884	3.6887757
4819	3.6829569	4852	3.6859208	4885	3.6888646
4820	3.6830470	4853	3.6860103	4886	3.6889535
4821	3.6831371	4854	3.6860998	4887	3.6890423
4822	3.6832272	4855	3.6861892	4888	3.6891312
4823	3.6833173	4856	3.6862787	4889	3.6892200
4824	3.6834073	4857	3.6863681	4890	3.6893089
4825	3.6834973	4858	3.6864575	4891	3.6893977
4826	3.6835873	4859	3.6865469	4892	3.6894864
4827	3.6836773	4860	3.6866363	4893	3.6895752
4828	3.6837673	4861	3.6867256	4894	3.6896640
4829	3.6838572	4862	3.6868150	4895	3.6897527
4830	3.6839471	4863	3.6869043	4896	3.6898414
4831	3.6840370	4864	3.6869936	4897	3.6899301
4832	3.6841269	4865	3.6870828	4898	3.6900188
4833	3.6842168	486	3.6871721	4899	3.6901074
4834	3.6843066	4867	3.6872613	4900	3.6901961

N.	Logarith.	N.	Logarith.	N.	Logarith.
4901	3.6902847	4934	3.6931991	4967	3.6960942
4902	3.6903733	4935	3.6932872	4968	3.6961816
4903	3.6904619	4936	3.6933752	4969	3.6962690
4904	3.6905505	4937	3.6934631	4970	3.6963564
4905	3.6906390	4938	3.6935511	4971	3.6964438
4906	3.6907275	4939	3.6936390	4972	3.6965311
4907	3.6908161	4940	3.6937269	4973	3.6966185
4908	3.6909046	4941	3.6938149	4974	3.6967058
4909	3.6909930	4942	3.6939027	4975	3.6967931
4910	3.6910815	4943	3.6939906	4976	3.6968804
4911	3.6911699	4944	3.6940785	4977	3.6969676
4912	3.6912584	4945	3.6941663	4978	3.6970549
4913	3.6913468	4946	3.6942541	4979	3.6971421
4914	3.6914352	4947	3.6943419	4980	3.6972293
4915	3.6915235	4948	3.6944297	4981	3.6973165
4916	3.6916119	4949	3.6945175	4982	3.6974037
4917	3.6917002	4950	3.6946052	4983	3.6974909
4918	3.6917885	4951	3.6946929	4984	3.6975780
4919	3.6918768	4952	3.6947806	4985	3.6976652
4920	3.6919651	4953	3.6948683	4986	3.6977523
4921	3.6920534	4954	3.6949560	4987	3.6978394
4922	3.6921416	4955	3.6950437	4988	3.6979264
4923	3.6922298	4956	3.6951313	4989	3.6980135
4924	3.6923180	4957	3.6952189	4990	3.6981005
4925	3.6924062	4958	3.6953065	4991	3.6981876
4926	3.6924944	4959	3.6953941	4992	3.6982746
4927	3.6925826	4960	3.6954817	4993	3.6983616
4928	3.6926707	4961	3.6955692	4994	3.6984485
4929	3.6927588	4962	3.6956568	4995	3.6985335
4930	3.6928469	4963	3.6957443	4996	3.6986224
4931	3.6929350	4964	3.6958318	4997	3.6987093
4932	3.6930231	4965	3.6959193	4998	3.6987963
4933	3.6931111	4966	3.6960067	4999	3.6988831
4934	3.6931991	4967	3.6960942	5000	3.6989700

N.	Logarith.	N.	Logarith.	N.	Logarith.
5001	3.6990569	5034	3.7019132	5067	3.7047509
5002	3.6991437	5035	3.7019995	5068	3.7048366
5003	3.6992305	5036	3.7020857	5069	3.7049223
5004	3.6993173	5037	3.7021719	5070	3.7050080
5005	3.6994041	5038	3.7022582	5071	3.7050936
5006	3.6994908	5039	3.7023444	5072	3.7051792
5007	3.6995776	5040	3.7024305	5073	3.7052649
5008	3.6996643	5041	3.7025167	5074	3.7053505
5009	3.6997510	5042	3.7026028	5075	3.7054360
5010	3.6998377	5043	3.7026890	5076	3.7055216
5011	3.6999244	5044	3.7027751	5077	3.7056072
5012	3.7000111	5045	3.7028612	5078	3.7056927
5013	3.7000977	5046	3.7029472	5079	3.7057782
5014	3.7001843	5047	3.7030333	5080	3.7058637
5015	3.7002709	5048	3.7031193	5081	3.7059492
5016	3.7003575	5049	3.7032054	5082	3.7060347
5017	3.7004441	5050	3.7032914	5083	3.7061201
5018	3.7005307	5051	3.7033774	5084	3.7062055
5019	3.7006172	5052	3.7034633	5085	3.7062910
5020	3.7007037	5053	3.7035493	5086	3.7063764
5021	3.7007902	5054	3.7036352	5087	3.7064617
5022	3.7008767	5055	3.7037212	5088	3.7065471
5023	3.7009632	5056	3.7038071	5089	3.7066324
5024	3.7010496	5057	3.7038929	5090	3.7067178
5025	3.7011361	5058	3.7039788	5091	3.7068031
5026	3.7012225	5059	3.7040647	5092	3.7068884
5027	3.7013089	5060	3.7041505	5093	3.7069737
5028	3.7013953	5061	3.7042363	5094	3.7070589
5029	3.7014816	5062	3.7043221	5095	3.7071442
5030	3.7015680	5063	3.7044079	5096	3.7072294
5031	3.7016543	5064	3.7044937	5097	3.7073146
5032	3.7017406	5065	3.7045794	5098	3.7073998
5033	3,7018269	5066	3.7046652	5099	3.7074850
5034	3.7019132	5067	3.7047509	5100	3.7075702

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5101	3.7076553	5134	3.7104559	5167	3.7132385
5102	3.7077405	5135	3.7105404	5168	3.7133225
5103	3.7078256	5136	3.7106250	5169	3.7134065
5104	3.7079107	5137	3.7107096	5170	3.7134905
5105	3.7079957	5138	3.7107941	5171	3.7135745
5106	3.7080808	5139	3.7108786	5172	3.7136585
5107	3.7081659	5140	3.7109631	5173	3.7137425
5108	3.7082509	5141	3.7110476	5174	3.7138264
5109	3.7083359	5142	3.7111321	5175	3.7139104
5110	3.7084209	5143	3.7112165	5176	3.7139943
5111	3.7085059	5144	3.7113010	5177	3.7140782
5112	3.7085908	5145	3.7113854	5178	3.7141620
5113	3.7086758	5146	3.7114698	5179	3.7142459
5114	3.7087607	5147	3.7115542	5180	3.7143298
5115	3.7088456	5148	3.7116385	5181	3.7144136
5116	3.7089305	5149	3.7117229	5182	3.7144974
5117	3.7090154	5150	3.7118072	5183	3.7145812
5118	3.7091003	5151	3.7118915	5184	3.7146650
5119	3.7091851	5152	3.7119759	5185	3.7147488
5120	3.7092700	5153	3.7120601	5186	3.7148325
5121	3.7093548	5154	3.7121444	5187	3.7149162
5122	3.7094396	5155	3.7122287	5188	3.7150000
5123	3.7095244	5156	3.7123129	5189	3.7150837
5124	3.7096091	5157	3.7123971	5190	3.7151674
5125	3.7096939	5158	3.7124813	5191	3.7152510
5126	3.7097786	5159	3.7125655	5192	3.7153347
5127	3.7098633	5160	3.7126497	5193	3.7154183
5128	3.7099480	5161	3.7127339	5194	3.7155019
5129	3.7100327	5162	3.7128180	5195	3.7155856
5130	3.7101174	5163	3.7129021	5196	3.7156691
5131	3.7102020	5164	3.7129862	5197	3.7157527
5132	3.7102866	5165	3.7130703	5198	3.7158363
5133	3.7103713	5166	3.7131544	5199	3.7159198
5134	3.7104559	5167	3.7132385	5200	3.7160033

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5201	3.7160869	5234	3.7188337	5267	3.7215633
5202	3.7161703	5235	3.7189167	5268	3.7216458
5203	3.7162538	5236	3.7189996	5269	3.7217282
5204	3.7163373	5237	3.7190826	5270	3.7218106
5205	3.7164207	5238	3.7191655	5271	3.7218930
5206	3.7165042	5239	3.7192484	5272	3.7219754
5207	3.7165876	5240	3.7193313	5273	3.7220578
5208	3.7166710	5241	3.7194142	5274	3.7221401
5209	3.7167544	5242	3.7194970	5275	3.7222225
5210	3.7168377	5243	3.7195799	5276	3.7223048
5211	3.7169211	5244	3.7196627	5277	3.7223871
5212	3.7170044	5245	3.7197455	5278	3.7224694
5213	3.7170877	5246	3.7198283	5279	3.7225517
5214	3.7171710	5247	3.7199111	5280	3.7226339
5215	3.7172543	5248	3.7199938	5281	3.7227162
5216	3.7173376	5249	3.7200766	5282	3.7227984
5217	3.7174208	5250	3.7201593	5283	3.7228806
5218	3.7175041	5251	3.7202420	5284	3.7229628
5219	3.7175873	5252	3.7203247	5285	3.7230450
5220	3.7176705	5253	3.7204074	5286	3.7231272
5221	3.7177537	5254	3.7204901	5287	3.7232093
5222	3.7178369	5255	3.7205727	5288	3.7232914
5223	3.7179200	5256	3.7206554	5289	3.7233736
5224	3.7180032	5257	3.7207380	5290	3.7234557
5225	3.7180863	5258	3.7208206	5291	3.7235378
5226	3.7181694	5259	3.7209032	5292	3.7236198
5227	3.7182525	5260	3.7209857	5293	3.7237019
5228	3.7183356	5261	3.7210683	5294	3.7237839
5229	3.7184186	5262	3.7211508	5295	3.7238660
5230	3.7185017	5263	3 7212334	5296	3.7239480
5231	3.7185847	5264	3.7213159	5297	3.7240300
5232	3.7186677	5265	3.7213984	5298	3.7241120
5233	3.7187507	5266	3.7214809	5299	3.7241939
5234	3.7188337	5267	3.7215633	5300	3.7242759

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5301	3.7243578	5334	3.7270530	5367	3.7297316
5302	3.7244397	5335	3.7271344	5368	3.7298125
5303	3.7245216	5336	3.7272158	5369	3.7298934
5304	3.7246035	5337	3.7272972	5370	3.7299743
5305	3.7249854	5338	3.7273786	5371	3.7300552
5306	3.7247672	5339	3.7274599	5372	3.7301360
5307	3.7248491	5340	3.7275413	5373	3.7302168
5308	3.7249309	5341	3.7276226	5374	3.7302977
5309	3.7250127	5342	3.7277039	5375	3.7303785
5310	3.7250945	5343	3.7277852	5376	3.7304593
5311	3.7251763	5344	3.7278664	5377	3.7305400
5312	3.7252581	5345	3.7279477	5378	3.7306208
5313	3.7253398	5346	3.7280290	5379	3.7307015
5314	3.7254215	5347	3.7281102	5380	3.7307823
5315	3.7255033	5348	3.7281914	5381	3.7308630
5316	3.7255850	5349	3.7282726	5382	3.7309437
5317	3.7256667	5350	3.7283538	5383	3.7310244
5318	3.7257483	5351	3.7284349	5384	3.7311051
5319	3.7258300	5352	3.7285161	5385	3.7311857
5320	3.7259116	5353	3.7285972	5386	3.7312663
5321	3.7259933	5354	3.7286784	5387	3.7313470
5322	3.7260749	5355	3.7287595	5388	3.7314276
5323	3.7261565	5356	3.7288406	5389	3.7315082
5324	3.7262380	5357	3.7289216	5390	3.7315888
5325	3.7263196	5358	3.7290027	5391	3.7316693
5326	3.7264012	5359	3.7290838	5392	3.7317499
5327	3.7264827	5360	3.7291648	5393	3.7318304
5328	3.7265642	5361	3.7292458	5394	3.7319109
5329	3.7266457	5362	3.7293268	5395	3.7319914
5330	3.7267272	5363	3.7294078	5396	3.7320719
5331	3.7268087	5364	3.7294888	5397	3.7321524
5332	3.7268901	5365	3.7295697	5398	3.7322329
5333	3.7269716	5366	3.7296507	5399	3.7323133
5334	3.7270530	5367	3.7297316	5400	3.7323938

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5401	3.7324742
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5407	3.7329564
5408	3.7330367
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5410	3.7331973
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5413	3.7334380
5414	3.7335182
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5418	3.7338390
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5431	3.7348798
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5440	3.7355989
5441	3.7356787
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5445	3.7359979
5446	3.7360776
5447	3.7361574
5448	3.7362371
5449	3.7363168
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5451	3.7364762
5452	3.7365558
5453	3.7366355
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5455	3.7367948
5456	3.7368744
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5464	3.7375107
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5467	3.7377491
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5469	3.7379079
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5472	3.7381461
5473	3.7382254
5474	3.7383048
5475	3.7383841
5476	3.7384634
5477	3.7385427
5478	3.7386220
5479	3.7387013
5480	3.7387806
5481	3.7388598
5482	3.7389390
5483	3.7390182
5484	3.7390974
5485	3.7391766
5486	3.7391558
5487	3.7393350
5488	3.7394141
5489	3.7394932
5490	3.7395723
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5495	3.7399677
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5499	3.7402837
5500	3.7403627

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5501	3.7404416	5534	3.7430392	5567	3.7456212
5502	3.7405206	5535	3.7431176	5568	3.7456992
5503	3.7405995	5536	3.7431961	5569	3.7457772
5504	3.7406784	5537	3.7432745	5570	3.7458552
5505	3.7407573	5538	3.7433530	5571	3.7459332
5506	3.7408362	5539	3.7434314	5572	3.7460111
5507	3.7409151	5540	3.7435098	5573	3.7460890
5508	3.7409939	5541	3.7435881	5574	3.7461670
5509	3.7410728	5542	3.7436665	5575	3.7462449
5510	3.7411516	5543	3.7437449	5576	3.7463228
5511	3.7412304	5544	3.7438232	5577	3.7464006
5512	3.7413092	5545	3.7439015	5578	3.7464785
5513	3.7413880	5546	3.7439799	5579	3.7465564
5514	3.7414668	5547	3.7440582	5580	3.7466342
5515	3.7415455	5548	3.7441365	5581	3.7467120
5516	3.7416243	5549	3.7442147	5582	3.7467898
5517	3.7417030	5550	3.7442930	5583	3.7468676
5518	3.7417817	5551	3.7443712	5584	3.7469454
5519	3.7418604	5552	3.7444495	5585	3.7470232
5520	3.7419391	5553	3.7445277	5586	3.7471009
5521	3.7420177	5554	3.7446059	5587	3.7471787
5522	3.7420964	5555	3.7446841	5588	3.7472564
5523	3.7421750	5556	3.7447622	5589	3.7473341
5524	3.7422537	5557	3.7448404	5590	3.7474118
5525	3.7423323	5558	3.7449185	5591	3.7474895
5526	3.7424109	5559	3.7449967	5592	3.7475672
5527	3.7424895	5560	3.7450748	5593	3.7476448
5528	3.7425680	5561	3.7451529	5594	3.7477225
5529	3.7426466	5562	3.7452310	5595	3.7478001
5530	3.7427251	5563	3.7453091	5596	3.7478777
5531	3.7428037	5564	3.7453871	5597	3.7479553
5532	3.7428822	5565	3.7454652	5598	3.7480329
5533	3.7429607	5566	3.7455432	5599	3.7481105
5534	3.7430392	5567	3.7456212	5600	3.7481880

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5601	3.7482656	5634	3.7508168	5667	3.7533532
5602	3.7483431	5635	3.7508939	5668	3.7534298
5603	3.7484206	5636	3.7509710	5669	3.7535065
5604	3.7484981	5637	3.7510480	5670	3.7535831
5605	3.7485756	5638	3.7511251	5671	3.7536596
5606	3.7486531	5639	3.7512021	5672	3.7537362
5607	3.7487306	5640	3.7512791	5673	3.7538128
5608	3.7488080	5641	3.7513561	5674	3.7538893
5609	3.7488854	5642	3.7514331	5675	3.7539659
5610	3.7489629	5643	3.7515100	5676	3.7540424
5611	3.7490403	5644	3.7515870	5677	3.7541189
5612	3.7491177	5645	3.7516639	5678	3.7541954
5613	3.7491950	5646	3.7517409	5679	3.7542719
5614	3.7492724	5647	3.7518178	5680	3.7543483
5615	3.7493498	5648	3.7518947	5681	3.7544248
5616	3.7494271	5649	3.7519716	5682	3.7545012
5617	3.7495044	5650	3.7520484	5683	3.7545777
5618	3.7495817	5651	3.7521253	5684	3.7546541
5619	3.7496590	5652	3.7522022	5685	3.7547305
5620	3.7497363	5653	3.7522790	5686	3.7548069
5621	3.7498136	5654	3.7523558	5687	3.7548832
5622	3.7498908	5655	3.7524326	5688	3.7549596
5623	3.7499681	5656	3.7525094	5689	3.7550359
5624	3.7500453	5657	3.7525862	5690	3.7551123
5625	3.7501225	5658	3.7526629	5691	3.7551886
5626	3.7501997	5659	3.7527397	5692	3.7552649
5627	3.7502769	5660	3.7528164	5693	3.7553412
5628	3.7503541	5661	3.7528932	5694	3.7554175
5629	3.7504312	5662	3.7529699	5695	3.7554937
5630	3.7505084	5663	3.7530466	5696	3.7555700
5631	3.7505855	5664	3.7531232	5697	3.7556462
5632	3.7506626	5665	3.7531999	5698	3.7557224
5633	3.7507398	5666	3.7532766	5699	3.7557987
5634	3.7508168	5667	3.7533532	5700	3.7558749

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5701	3.7559510	5734	3.7584577	5767	3.7609500
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5703	3.7561034	5736	3.7586091	5769	3.7611005
5704	3.7561795	5737	3.7586848	5770	3.7611758
5705	3.7562556	5738	3.7587605	5771	3.7612511
5706	3.7563318	5739	3.7588362	5772	3.7613263
5707	3.7564079	5740	3.7589119	5773	3.7614016
5708	3.7564840	5741	3.7589875	5774	3.7614768
5709	3.7565600	5742	3.7590632	5775	3.7615520
5710	3.7566361	5743	3.7591388	5776	3.7616272
5711	3.7567122	5744	3 7592144	5777	3.7617024
5712	3.7567882	5745	3.7592900	5778	3.7617775
5713	3.7568642	5746	3.7593656	5779	3.7618527
5714	3.7569402	5747	3.7594412	5780	3.7619278
5715	3.7570162	5748	3.7595168	5781	3.7620030
5716	3.7570922	5749	3.7595923	5782	3.7620781
5717	3.7571682	5750	3.7596678	5783	3.7621532
5718	3.7572441	5751	3.7597434	5784	3.7622283
5719	3.7573201	5752	3.7598189	5785	3.7623034
5720	3.7573960	5753	3.7598944	5786	3.7623784
5721	3.7574719	5754	3.7599699	5787	3.7624535
5722	3.7575479	5755	3.7600453	5788	3.7625285
5723	3.7576237	5756	3.7601208	5789	3.7626035
5724	3.7576996	5757	3.7601962	5790	3.7626786
5725	3.7577755	5758	3.7602717	5791	3.7627536
5726	3.7578513	5759	3.7603471	5792	3.7628286
5727	3.7579272	5760	3.7604225	5793	3.7629035
5728	3.7580030	5761	3.7604979	5794	3.7629785
5729	3.7580788	5762	3.7605733	5795	3.7630534
5730	3.7581546	5763	3.7606486	5796	3.7631284
5731	3.7582304	5764	3.7607240	5797	3.7632033
5732	3.7583062	5765	3.7607993	5798	3.7632782
5733	3.7583819	5766	3.7608746	5799	3.7633531
5734	3.7584577	5767	3.7609500	5800	3.7634280

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5803	3.7636526	5836	3.7661153	5869	3.7685641
5804	3.7637274	5837	3.7661897	5870	3.7686381
5805	3.7638022	5838	3.7662641	5871	3.7687121
5806	3.7638770	5839	3.7663385	5872	3.7687860
5807	3.7639518	5840	3.7664128	5873	3.7688600
5808	3.7640266	5841	3.7664872	5874	3.7689339
5809	3.7641014	5842	3.7665616	5875	3.7690079
5810	3.7641761	5843	3.7666359	5876	3.7690818
5811	3.7642509	5844	3.7667102	5877	3.7691557
5812	3.7643256	5845	3.7667845	5878	3.7692296
5813	3.7644003	5846	3.7668588	5879	3.7693035
5814	3.7644750	5847	3.7669331	5880	3.7693773
5815	3.7645497	5848	3.7670074	5881	3.7694512
5816	3.7646244	5849	3.7670816	5882	3.7695250
5817	3.7646991	5850	3.7671559	5883	3.7695988
5818	3.7647737	5851	3.7672301	5884	3.7696727
5819	3.7648484	5852	3.7673043	5885	3.7697465
5820	3.7649230	5853	3.7673785	5886	3.7698203
5821	3.7649976	5854	3.7674527	5887	3.7698940
5822	3.7650722	5855	3.7675269	5888	3.7699678
5823	3.7651468	5856	3.7676011	5889	3.7700416
5824	3.7652214	5857	3.7676752	5890	3.7701153
5825	3.7652959	5858	3.7677494	5891	3.7701890
5826	3.7653705	5859	3.7678235	5892	3.7702627
5827	3.7654450	5860	3.7678976	5893	3.7703364
5828	3.7655195	5861	3.7679717	5894	3.7704101
5829	3.7655941	5862	3.7680458	5895	3.7704838
5830	3.7656686	5863	3.7681199	5896	3.7705575
5831	3.7657430	5864	3.7681940	5897	3.7706311
5832	3.7658175	5865	3.7682680	5898	3.7707048
5833	3.7658920	5866	3.7683421	5899	3.7707784
5834	3.7659664	5867	3.7684161	5900	3.7708520

N.	Logarith.	N.	Logarith.	N.	Logarith.
5901	3.7709256	5934	3.7733475	5967	3.7757560
5902	3.7709992	5935	3.7734207	5968	3.7758288
5903	3.7710728	5936	3.7734939	5969	3.7759016
5904	3.7711463	5937	3.7735670	5970	3.7759743
5905	3.7712199	5938	3.7736402	5971	3.7760471
5906	3.7712934	5939	3.7737133	5972	3.7761198
5907	3.7713670	5940	3.7737864	5973	3.7761925
5908	3.7714405	5941	3.7738596	5974	3.7762652
5909	3.7715140	5942	3.7739326	5975	3.7763379
5910	3.7715875	5943	3.7740057	5976	3.7764106
5911	3.7716610	5944	3.7740788	5977	3.7764833
5912	3.7717344	5945	3.7741519	5978	3.7765559
5913	3.7718079	5946	3.7742249	5979	3.7766286
5914	3.7718813	5947	3.7742979	5980	3.7767012
5915	3.7719547	5948	3.7743710	5981	3.7767738
5916	3.7720282	5949	3.7744440	5982	3.7768464
5917	3.7721016	5950	3.7745170	5983	3.7769190
5918	3.7721750	5951	3.7745899	5984	3.7769916
5919	3.7722483	5952	3.7746629	5985	3.7770642
5920	3.7723217	5953	3.7747359	5986	3.7771367
5921	3.7723951	5954	3.7748088	5987	3.7772093
5922	3.7724684	5955	3.7748818	5988	3.7772818
5923	3.7725417	5956	3.7749547	5989	3.7773543
5924	3.7726150	5957	3.7750276	5990	3.7774268
5925	3.7726884	5958	3.7751005	5991	3.7774993
5926	3.7727616	5959	3.7751734	5992	3.7775718
5927	3.7728349	5960	3.7752463	5993	3.7776443
5928	3.7729082	5961	3.7753191	5994	3.7777167
5929	3.7729814	5962	3.7753920	5995	3.7777892
5930	3.7730547	5963	3.7754648	5996	3.7778616
5931	3.7731279	5964	3.7755376	5997	3.7779340
5932	3.7732011	5965	3.7756104	5998	3.7780065
5933	3.7732743	5966	3.7756832	5999	3.7780789
5934	3.7733475	5967	3.7757560	6000	3.7781512

N.	Logarith.	N.	Logarith.	N.	Logarith.
6001	3.7782236	6034	3.7806053	6067	3.7829740
6002	3.7782960	6035	3.7806773	6068	3.7830456
6003	3.7783683	6036	3.7807492	6069	3.7831171
6004	3.7784407	6037	3.7808212	6070	3.7831887
6005	3.7785130	6038	3.7808931	6071	3.7832602
6006	3.7785853	6039	3.7809650	6072	3.7833318
6007	3.7786576	6040	3.7810369	6073	3.7834033
6008	3.7787299	6041	3.7811088	6074	3.7834748
6009	3.7788022	6042	3.7811807	6075	3.7835463
6010	3.7788745	6043	3.7812526	6076	3.7836178
6011	3.7789467	6044	3.7813245	6077	3.7836892
6012	3.7790190	6045	3.7813963	6078	3.7837607
6013	3.7790912	6046	3.7814681	6079	3.7838321
6014	3.7791634	6047	3.7815400	6080	3.7839036
6015	3.7792356	6048	3.7816118	6081	3.7839750
6016	3.7793078	6049	3.7816836	6082	3.7840464
6017	3.7793800	6050	3.7817554	6083	3.7841178
6018	3.7794522	6051	3.7818272	6084	3.7841892
6019	3.7795243	6052	3.7818989	6085	3.7842606
6020	3.7795965	6053	3.7819707	6086	3.7843319
6021	3.7796686	6054	3.7820424	6087	3.7844033
6022	3.7797408	6055	3.7821141	6088	3.7844746
6023	3.7798129	6056	3.7821859	6089	3.7845460
6024	3.7798850	6057	3.7822576	6090	3.7846173
6025	3.7799571	6058	3.7823293	6091	3.7846886
6026	3.7800291	6059	3.7824010	6092	3.7847599
6027	3.7801012	6060	3.7824726	6093	3.7848312
6028	3.7801732	6061	3.7825443	6094	3.7849024
6029	3.7802453	6062	3.7826159	6095	3.7849737
6030	3.7803173	6063	3.7826876	6096	3.7850450
6031	3.7803893	6064	3.7827592	6097	3.7851162
6032	3.7804613	6065	3.7828308	6098	3.7851874
6033	3.7805333	6066	3.7829024	6099	3.7852586
6034	3.7806053	6067	3.7829740	6100	3.7853298

N.	Logarith.	N.	Logarith	N.	Logarith.
6101	3.7854010	6134	3.7877438	6167	3.7900739
6102	3.7854722	6135	3.7878146	6168	3.7901444
6103	3.7855434	6136	3.7878853	6169	3.7902148
6104	3.7856145	6137	3.7879561	6170	3.7902852
6105	3.7856857	6138	3.7880269	6171	3.7903555
6106	3.7857568	6139	3.7880976	6172	3.7904259
6107	3.7858279	6140	3.7881684	6173	3.7904963
6108	3.7858990	6141	3.7882391	6174	3.7905666
6109	3.7859701	6142	3.7883098	6175	3.7906370
6110	3.7860412	6143	3.7883805	6176	3.7907073
6111	3.7861123	6144	3.7884512	6177	3.7907776
6112	3.7861833	6145	3.7885219	6178	3.7908479
6113	3.7862544	6146	3.7885926	6179	3.7909182
6114	3.7863254	6147	3.7886632	6180	3.7909885
6115	3.7863965	6148	3.7887339	6181	3.7910587
6116	3.7864675	6149	3.7888045	6182	3.7911290
6117	3.7865385	6150	3.7888751	6183	3.7911992
6118	3.7866095	6151	3.7889457	6184	3.7912695
6119	3.7866805	6152	3.7890163	6185	3.7913397
6120	3.7867514	6153	3.7890869	6186	3.7914099
6121	3.7868224	6154	3.7891575	6187	3.7914801
6122	3.7868933	6155	3.7892281	6188	3.7915503
6123	3.7869643	6156	3.7892986	6189	3.7916205
6124	3.7870352	6157	3.7893692	6190	3.7916906
6125	3.7871061	6158	3.7894397	6191	3.7917608
6126	3.7871770	6159	3.7895102	6192	3.7918309
6127	3.7872479	6160	3.7895807	6193	3.7919011
6128	3.7873188	6161	3.7896512	6194	3.7919712
6129	3.7873896	6162	3.7897217	6195	3.7920413
6130	3.7874605	6163	3.7897922	6196	3.7921114
6131	3.7875313	6164	3.7898626	6197	3.7921815
6132	3.7876021	6165	3.7899331	6198	3.7922516
6133	3.7876730	6166	3.7900035	6199	3.7923216
6134	3.7877438	6167	3.7900739	6200	3.7923917

N	Logarith.	N.	Logarith.	N.	Logarith.
6201	3.7924617	6234	3.7947668	6267	3.7970597
6202	3.7925318	6235	3.7948365	6268	3.7971290
6203	3.7926018	6236	3.7949061	6269	3.7971983
6204	3.7926718	6237	3.7949757	6270	3.7972675
6205	3.7927418	6238	3.7950454	6271	3.7973368
6206	3.7928118	6239	3.7951150	6272	3.7974060
6207	3.7928817	6240	3.7951846	6273	3.7974753
6208	3.7929517	6241	3.7952542	6274	3.7975445
6209	3.7930217	6242	3.7953238	6275	3.7976137
6210	3.7930916	6243	3.7953933	6276	3.7976829
6211	3.7931615	6244	3.7954629	6277	3.7977521
6212	3.7932314	6245	3.7955324	6278	3.7978213
6213	3.7933014	6246	3.7956020	6279	3.7978905
6214	3.7933712	6247	3.7956715	6280	3.7979596
6215	3.7934411	6248	3.7957410	6281	3.7980288
6216	3.7935110	6249	3.7958105	6282	3.7980979
6217	3.7935809	6250	3.7958800	6283	3.7981671
6218	3.7936507	6251	3.7959495	6284	3.7982362
6219	3.7937206	6252	3.7960190	6285	3.7983053
6220	3.7937904	6253	3.7960884	6286	3.7983744
6221	3.7938602	6254	3.7961579	6287	3.7984435
6222	3.7939300	6255	3.7962273	6288	3.7985125
6223	3.7939998	6256	3.7962967	6289	3.7985816
6224	3.7940696	6257	3.7963662	6290	3.7986506
6225	3.7941394	6258	3.7964356	6291	3.7987197
6226	3.7942091	6259	3.7965050	6292	3.7987887
6227	3.7942789	6260	3.7965743	6293	3.7988577
6228	3.7943486	6261	3.7966437	6294	3.7989267
6229	3.7944183	6262	3.7967131	6295	3.7989957
6230	3.7944880	6263	3.7967824	6296	3.7990647
6231	3.7945578	6264	3.7968517	6297	3.7991337
6232	3.7946274	6265	3.7969211	6298	3.7992027
6233	3.7946971	6266	3.7969904	6299	3.7992716
6234	3.7947668	6267	3.7970597	6300	3.7993405

N.	Logarith.	N.	Logarith.	N.	Logarith.
6301	3.7994095	6334	3.8016781	6367	3.8039348
6302	3.7994784	6335	3.8017466	6368	3.8040031
6303	3.7995473	6336	3.8018152	6369	3.8040712
6304	3.7996162	6337	3.8018837	6370	3.8041394
6305	3.7996851	6338	3.8019522	6371	3.8042076
6306	3.7997540	6339	3.8020208	6372	3.8042758
6307	3.7998228	6340	3.8020893	6373	3.8043439
6308	3.7998917	6341	3.8021578	6374	3.8044121
6309	3.7999605	6342	3.8022262	6375	3.8044802
6310	3.8000294	6343	3.8022947	6376	3.8045483
6311	3.8000982	6344	3.8023632	6377	3.8046164
6312	3.8001670	6345	3.8024316	6378	3.8046845
6313	3.8002358	6346	3.8025001	6379	3.8047526
6314	3.8003046	6347	3.8025685	6380	3.8048207
6315	3.8003734	6348	3.8026369	6381	3.8048887
6316	3.8004421	6349	3.8027053	6382	3.8049568
6317	3.8005109	6350	3.8027737	6383	3.8050248
6318	3.8005796	6351	3.8028421	6384	3.8050929
6319	3.8006484	6352	3.8029105	6385	3.8051609
6320	3.8007171	6353	3.8029789	6386	3.8052289
6321	3.8007858	6354	3.8030472	6387	3.8052969
6322	3 8008545	6355	3.8031156	6388	3.8053649
6323	3.8009232	6356	3.8031839	6389	3.8054329
6324	3.8009919	6357	3.8032522	6390	3.8055009
6325	3.8010605	6358	3.8033205	6391	3.8055688
6326	3.8011292	6359	3.8033888	6392	3.8056368
6327	3.8011978	6360	3.8034571	6393	3.8057047
6328	3.8012665	6361	3.8035254	6394	3.8057726
6329	3.8013351	6362	3.8035937	6395	3.8058405
6330	3.8014037	6363	3.8036619	6396	3.8059085
6331	3.8014723	6364	3.8037302	6397	3.8059764
6332	3.8015409	6365	3.8037984	6398	3.8060442
6333	3.8016095	6366	3.8038666	6399	3.8061121
6334	3.8016781	6367	3.8039348	6400	3.8061800

N.	Logarith.	N.	Logarith.	N.	Logarith.
6401	3.8062478	6434	3.8084811	6467	3.8107029
6402	3.8063157	6435	3.8085485	6468	3.8107700
6403	3.8063835	6436	3.8086160	6469	3.8108371
6404	3.8064513	6437	3.8086835	6470	3.8109043
6405	3.8065191	6438	3.8087510	6471	3.8109714
6406	3.8065869	6439	3.8088184	6472	3.8110385
6407	3.8066547	6440	3.8088859	6473	3.8111056
6408	3.8067225	6441	3.8089533	6474	3.8111727
6409	3.8067903	6442	3.8090207	6475	3.8112398
6410	3.8068580	6443	3.8090881	6476	3.8113068
6411	3.8069258	6444	3.8091555	6477	3.8113739
6412	3.8069935	6445	3.8092229	6478	3.8114409
6413	3.8070612	6446	3.8092903	6479	3.8115080
6414	3.8071290	6447	3.8093577	6480	3.8115750
6415	3.8071967	6448	3.8094250	6481	3.8116420
6416	3.8072644	6449	3.8094924	6482	3.8117090
6417	3.8073320	6450	3.8095597	6483	3.8117760
6418	3.8073997	6451	3.8096270	6484	3.8118430
6419	3.8074674	6452	3.8096944	6485	3.8119100
6420	3.8075350	6453	3.8097617	6486	3.8119769
6421	3.8076027	6454	3.8098290	6487	3.8120439
6422	3.8076703	6455	3.8098962	6488	3.8121108
6423	3.8077379	6456	3.8099635	6489	3.8121778
6424	3.8078055	6457	3.8100308	6490	3.8122447
6425	3.8078731	6458	3.8100980	6491	3.8123116
6426	3.8079407	6459	3.8101653	6492	3.8123785
6427	3.8080083	6460	3.8102325	6493	3.8124454
6428	3.8080759	6461	3.8102997	6494	3.8125123
6429	3.8081434	6462	3.8103670	6495	2.8125792
6430	3.8082110	6463	3.8104342	6496	3.8126460
6431	3.8082785	6464	3.8105013	6497	3.8127129
6432	3.8083460	6465	3.8105685	6498	3.8127797
6433	3.8084136	6466	3.8106357	6499	3.8128465
6434	3.8084811	6467	3.8107029	6500	3.8129134

N.	Logarith.	N.	Logarith.	N.	Logarith.
6501	3.8129802	6534	3.8151791	6567	3.8173670
6502	3.8130470	6535	3.8152456	6568	3.8174331
6503	3.8131138	6536	3.8153120	6569	3.8174993
6504	3.8131805	6537	3.8153785	6570	3.8175654
6505	3.8132473	6538	3.8154449	6571	3.8176315
6506	3.8133141	6539	3.8155113	6572	3.8176976
6507	3.8133808	6540	3.8155777	6573	3.8177636
6508	3.8134475	6541	3.8156441	6574	3.8178297
6509	3.8135143	6542	3.8157105	6575	3.8178958
6510	3.8135810	6543	3.8157769	6576	3.8179618
6511	3.8136477	6544	3.8158433	6577	3.8180278
6512	3.8137144	6545	3.8159096	6578	3.8180939
6513	3.8137811	6546	3.8159760	6579	3.8181599
6514	3.8138478	6547	3.8160423	6580	3.8182259
6515	3.8139144	6548	3.8161087	6581	3.8182919
6516	3.8139811	6549	3.8161750	6582	3.8183579
6517	3.8140477	6550	3.8162413	6583	3.8184239
6518	3.8141144	6551	3.8163076	6584	3.8184898
6519	3.8141810	6552	3.8163739	6585	3.8185558
6520	3.8142476	6553	3.8164402	6586	3.8186217
6521	3.8143142	6554	3.8165064	6587	3.8186877
6522	3.8143808	6555	3.8165727	6588	3.8187536
6523	3.8144474	6556	3.8166389	6589	3.8188195
6524	3.8145140	6557	3.8167052	6590	3.8188854
6525	3.8145805	6558	3.8167714	6591	3.8189513
6526	3.8146471	6559	3.8168376	6592	3.8190172
6527	3.8147136	6560	3.8169038	6593	3.8190831
6528	3.8147801	6561	3.8169700	6594	3.8191489
6529	3.8148467	6562	3.8170362	6595	3.8192148
6530	3.8149132	6563	3.8171024	6596	3.8192806
6531	3.8149797	6564	3.8171686	6597	3.8193465
6532	3.8150462	6565	3.8172347	6598	3.8194123
6533	3.8151127	6566	3.8173009	6599	3.8194781
6534	3.8151791	6567	3.8173670	6600	3.8195439

N.	Logarith.	N.	Logarith.	N.	Logarith.
6601	3.8196097	6634	3.8217755	6667	3.8239305
6602	3.8196755	6635	3.8218409	6668	3.8239956
6603	3.8197413	6636	3.8219064	6669	3.8240607
6604	3.8198071	6637	3.8219718	6670	3.8241258
6605	3.8198728	6638	3.8220372	6671	3.8241909
6606	3.8199386	6639	3.8221027	6672	3.8242560
6607	3.8200043	6640	3.8221681	6673	3.8243211
6608	3.8200700	6641	3.8222335	6674	3.8243862
6609	3.8201358	6642	3.8222989	6675	3.8244513
6610	3.8202015	6643	3.8223643	6676	3.8245163
6611	3.8202672	6644	3.8224296	6677	3.8245814
6612	3.8203328	6645	3.8224950	6678	3.8246464
6613	3.8203985	6646	3.8225603	6679	3.8247114
6614	3.8204642	6647	3.8226257	6680	3.8247765
6615	3.8205298	6648	3.8226910	6681	3.8248415
6616	3.8205955	6649	3.8227563	6682	3.8249065
6617	3.8206611	6650	3.8228216	6683	3.8249715
6618	3.8207268	6651	3.8228869	6684	3.8250364
6619	3.8207924	6652	3.8229522	6685	3.8251014
6620	3.8208580	6653	3.8230175	6686	3.8251664
6621	3.8209236	6654	3.8230828	6687	3.8252313
6622	3.8209892	6655	3.8231481	6688	3.8252963
6623	3.8210548	6656	3.8232133	6689	3.8253612
6624	3.8211203	6657	3.8232786	6690	3.8254261
6625	3.8211859	6658	3.8233438	6691	3.8254910
6626	3.8212514	6659	3.8234090	6692	3.8255559
6627	3.8213170	6660	3.8234742	6693	3.8256208
6628	3.8213825	6661	3.8235394	6694	3.8256857
6629	3.8214480	6662	3.8236046	6695	3.8257506
6630	3.8215135	6663	3.8236698	6696	3.8258154
6631	3.8215790	6664	3.8237350	6697	3.8258803
6632	3.8216445	6665	3.8238002	6698	3.8259451
6633	3.8217100	6666	3.8238653	6699	3.8260100
6634	3.8217755	6667	3.8239305	6700	3.8260748

N.	Logarith.	N.	Logarith.	N.	Logarith.
6701	3.8261396	6734	3.8282731	6767	3.8303962
6702	3.8262044	6735	3.8283376	6768	3.8304603
6703	3.8262692	6736	3.8284021	6769	3.8305245
6704	3.8263340	6737	3.8284665	6770	3.8305887
6705	3.8263988	6738	3.8285310	6771	3.8306528
6706	3.8264635	6739	3.8285955	6772	3.8307169
6707	3.8265283	6740	3.8286599	6773	3.8307811
6708	3.8265931	6741	3.8287243	6774	3.8308452
6709	3.8266578	6742	3.8287887	6775	3.8309093
6710	3.8267225	6743	3.8288532	6776	3.8309734
6711	3.8267872	6744	3.8289176	6777	3.8310375
6712	3.8268519	6745	3.8289820	6778	3.8311016
6713	3.8269166	6746	3.8290463	6779	3.8311656
6714	3.8269813	6747	3.8291107	6780	3.8312297
6715	3.8270460	6748	3.8291751	6781	3.8312937
6716	3.8271107	6749	3.8292394	6782	3.8313578
6717	3.8271753	6750	3.8293038	6783	3.8314218
6718	3.8272400	6751	3.8293681	6784	3.8314858
6719	3.8273046	6752	3.8294324	6785	3.8315499
6720	3.8273693	6753	3.8294967	6786	3.8316139
6721	3.8274339	6754	3.8295611	6787	3.8316778
6722	3.8274985	6755	3.8296254	6788	3.8317418
6723	3.8275631	6756	3.8296896	6789	3.8318058
6724	3.8276277	6757	3.8297539	6790	3.8318698
6725	3.8276923	6758	3.8298182	6791	3.8319337
6726	3.8277569	6759	3.8298824	6792	3.8319977
6727	3.8278214	6760	3.8299467	6793	3.8320616
6728	3.8278860	6761	3.8300109	6794	3.8321255
6729	3.8279505	6762	3.8300752	6795	3.8321895
6730	3.8280151	6763	3.8301394	6796	3.8322534
6731	3.8280796	6764	3.8302036	6797	3.8323173
6732	3.8281441	6765	3.8302678	6798	3.8323812
6733	3.8282086	6766	3.8303320	6799	3.8324450
6734	3.8282731	6767	3.8303962	6800	3.8325089

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6807	3.8329558
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6812	3.8332746
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6819	3.8337207
6820	3.8337844
6821	3.8338480
6822	3.8339117
6823	3.8339754
6824	3.8340390
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6834	3.8346750
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6837	3.8348656
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6839	3.8349926
6840	3.8350561
6841	3.8351196
6842	3.8351831
6843	3.8352465
6844	3.8353100
6845	3.8353735
6846	3.8354369
6847	3.8355003
6848	3.8355638
6849	3.8356272
6850	3.8356906
6851	3.8357540
6852	3.8358174
6853	3.8358807
6854	3.8359441
6855	3.8360075
6856	3.8360708
6857	3.8361341
6858	3.8361975
6859	3.8362608
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6870	3.8369567
6871	3.8370199
6872	3.8370832
6873	3.8371463
6874	3.8372095
6875	3.8372727
6876	3.8373359
6877	3.8373990
6878	3.8374622
6879	3.8375253
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6881	3.8376516
6882	3.8377147
6883	3.8377778
6884	3.8378409
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6886	3.8379670
6887	3.8380301
6888	3.8380931
6889	3.8381562
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6892	3.8383453
6893	3.8384083
6894	3.8384713
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6902	3.8389750	6935	3.8410465	6968	3.8431081
6903	3.8390379	6936	3.8411091	6969	3.8431705
6904	3.8391008	6937	3.8411717	6970	3.8432328
6905	3.8391637	6938	3.8412343	6971	3.8432951
6906	3.8392266	6939	3.8412969	6972	3.8433574
6907	3.8392895	6940	3.8413595	6973	3.8434197
6908	3.8393523	6941	3.8414220	6974	3.8434819
6909	3.8394152	6942	3.8414846	6975	3.8435442
6910	3.8394780	6943	3.8415472	6976	3.8436065
6911	3.8395409	6944	3.8416097	6977	3.8436687
6912	3.8396037	6945	3.8416722	6978	3.8437310
6913	3.8396666	6946	3.8417348	6979	3.8439532
6914	3.8397294	6947	3.8417973	6980	3.8438554
6915	3.8397922	6948	3.8418598	6981	3.8439176
6916	3.8398550	6949	3.8419223	6982	3.8439798
6917	3.8399178	6950	3.8419848	6983	3.8440420
6918	3.8399806	6951	3.8420473	6984	3.8441042
6919	3.8400433	6952	3.8421098	6985	3.8441664
6920	3.8401061	6953	3.8421722	6986	3.8442286
6921	3.8401688	6954	3.8422347	6987	3.8442907
6922	3.8402316	6955	3.8422971	6988	3.8443529
6923	3.8402943	6956	3.8423596	6989	3.8444150
6924	3.8403571	6957	3.8424220	6990	3.8444772
6925	3.8404198	6958	3.8424844	6991	3.8445393
6926	3.8404825	6959	3.8425468	6992	3.8446014
6927	3.8405452	6960	3.8426092	6993	3.8446635
6928	3.8406079	6961	3.8426716	6994	3.8447256
6929	3.8406706	6962	3.8427340	6995	3.8447877
6930	3.8407332	6963	3.8427964	6996	3.8448498
6931	3.8407959	6964	3.8428588	6997	3.8449119
6932	3.8408586	6965	3.8429211	6998	3.8449739
6933	3.8409212	6966	3.8429835	6999	3.8450360
6934	3.8409838	6967	3.8430458	7000	3.8450980

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7002	3.8452221	7035	3.8472641	7068	3.8492965
7003	3.8452841	7036	3.8473258	7069	3.8493580
7004	3.8453461	7037	3.8473876	7070	3.8494194
7005	3.8454081	7038	3.8474493	7071	3.8494808
7006	3.8454701	7039	3.8475110	7072	3.8495423
7007	3.8455321	7040	3.8475727	7073	3.8496037
7008	3.8455941	7041	3.8476343	7074	3.8496651
7009	3.8456561	7042	3.8476960	7075	3.8497264
7010	3.8457180	7043	3.8477577	7076	3.8497878
7011	3.8457800	7044	3.8478193	7077	3.8498492
7012	3.8458419	7045	3.8478810	7078	3.8499106
7013	3.8459038	7046	3.8479426	7079	3.8499719
7014	3.8459658	7047	3.8480043	7080	3.8500333
7015	3.8460277	7048	3.8480659	7081	3.8500946
7016	3.8460896	7049	3.8481275	7082	3.8501559
7017	3.8461515	7050	3.8481891	7083	3.8502172
7018	3.8462134	7051	3.8482507	7084	3.8502786
7019	3.8462752	7052	3.8483123	7085	3.8503399
7020	3.8463371	7053	3.8483739	7086	3.8504011
7021	3.8463990	7054	3.8484355	7087	3.8504624
7022	3.8464608	7055	3.8484970	7088	3.8505237
7023	3.8465227	7056	3.8485586	7089	3.8505850
7024	3.8465845	7057	3.8486201	7090	3.8506462
7025	3.8466463	7058	3.8486817	7091	3.8507075
7026	3.8467081	7059	3.8487432	7092	3.8507687
7027	3.8467700	7060	3.8488047	7093	3.8508300
7028	3.8468318	7061	3.8488662	7094	3.8508912
7029	3.8468935	7062	3 8489277	7095	3.8509524
7030	3.8469553	7063	3.8489892	7096	3.8510136
7031	3.8470171	7064	3.8490507	7097	3.8510748
7032	3.8470789	7065	3.8491122	7098	3.8511360
7033	3.8471406	7066	3.8491736	7099	3.8511972
7034	3.8472024	7067	3.8492351	7100	3.8512583

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7102	3.8513807	7135	3.8533940	7168	3.8553980
7103	3.8514418	7136	3.8534548	7169	3.8554586
7104	3.8515030	7137	3.8535157	7170	3.8555192
7105	3.8515641	7138	3.8535765	7171	3.8555797
7106	3.8516252	7139	3.8536374	7172	3.8556403
7107	3.8516863	7140	3.8536982	7173	3.8557008
7108	3.8517474	7141	3.8537590	7174	3.8557614
7109	3.8518085	7142	3.8538198	7175	3.8558219
7110	3.8518696	7143	3.8538806	7176	3.8558824
7111	3.8519307	7144	3.8539414	7177	3.8559429
7112	3.8519917	7145	3.8540022	7178	3.8560035
7113	3.8520528	7146	3.8540630	7179	3.8560640
7114	3.8521139	7147	3.8541238	7180	3.8561244
7115	3.8521749	7148	3.8541845	7181	3.8561849
7116	3.8522359	7149	3.8542453	7182	3.8562454
7117	3.8522970	7150	3.8543060	7183	3.8563059
7118	3.8523580	7151	3.8543668	7184	3.8563663
7119	3.8524190	7152	3.8544275	7185	3.8564268
7120	3.8524800	7153	3.8544882	7186	3.8564872
7121	3.8525410	7154	3.8545489	7187	3.8565476
7122	3.8526020	7155	3.8546096	7188	3.8566081
7123	3.8526629	7156	3.8546703	7189	3.8566685
7124	3.8527239	7157	3.8547310	7190	3.8567289
7125	3.8527849	7158	3.8547917	7191	3.8567893
7126	3.8528458	7159	3.8548524	7192	3.8568497
7127	3.8529068	7160	3.8549130	7193	3.8569101
7128	3.8529677	7161	3.8549737	7194	3.8569704
7129	3.8530286	7162	3.8550343	7195	3.8570308
7130	3.8530895	7163	3.8550949	7196	3.8570912
7131	3.8531504	7164	3.8551556	7197	3.8571515
7132	3.8532113	7165	3.8552162	7198	3.8572118
7133	3.8532722	7166	3.8552768	7199	3.8572722
7134	3.8533331	7167	3.8553374	7200	3.8573325

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7201	3.8573928	7234	3.8593785	7267	3.8613552
7202	3.8574531	7235	3.8594385	7268	3.8614149
7203	3.8575134	7236	3.8594986	7269	3.8614747
7204	3.8575737	7237	3.8595586	7270	3.8615344
7205	3.8576340	7238	3.8596186	7271	3.8615941
7206	3.8576943	7239	3.8596786	7272	3.8616539
7207	3.8577545	7240	3.8597386	7273	3.8617136
7208	3.8578148	7241	3.8597985	7274	3.8617733
7209	3.8578750	7242	3.8598585	7275	3.8618330
7210	3.8579353	7243	3.8599185	7276	3.8618927
7211	3.8579955	7244	3.8599784	7277	3.8619524
7212	3.8580557	7245	3.8600384	7278	3.8620121
7213	3.8581159	7246	3.8600983	7279	3.8620717
7214	3.8581761	7247	3.8601583	7280	3.8621314
7215	3.8582363	7248	3.8602182	7281	3.8621910
7216	3.8582965	7249	3.8602781	7282	3.8622507
7217	3.8583567	7250	3.8603380	7283	3.8623103
7218	3.8584169	7251	3.8603979	7284	3.8623699
7219	3.8584770	7252	3.8604578	7285	3.8624296
7220	3.8585372	7253	3.8605177	7286	3.8624892
7221	3.8585973	7254	3.8605776	7287	3.8625488
7222	3 8586575	7255	3.8606374	7288	3.8626084
7223	3.8587176	7256	3.8606973	7289	3.8626679
7224	3.8587777	7257	3.8607571	7290	3.8627275
7225	3.8588379	7258	3.8608170	7291	3.8627871
7226	3.8588980	7259	3.8608768	7292	3.8628467
7227	3.8589581	7260	3.8609366	7293	3.8629062
7228	3.8590181	7261	3.8609964	7294	3.8629658
7229	3.8590782	7262	3.8610562	7295	3.8630253
7230	3.8591383	7263	3.8611160	7296	3.8630848
7231	3.8591984	7264	3.8611758	7297	3.8631443
7232	3.8592584	7265	3.8612356	7298	3.8632039
7233	3.8593185	7266	3.8612954	7299	3.8632634
7234	3.8593785	7267	3.8613552	7300	3.8633229

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7302	3.8634418	7335	3.8654001	7368	3.8673496
7303	3.8635013	7336	3.8654593	7369	3.8674086
7304	3.8635608	7337	3.8655185	7370	3.8674675
7305	3.8636202	7338	3.8655777	7371	3.8675264
7306	3.8636797	7339	3.8656369	7372	3.8675853
7307	3.8637391	7340	3.8656961	7373	3.8676442
7308	3.8637985	7341	3.8657552	7374	3.8677031
7309	3.8638580	7342	3.8658144	7375	3.8677620
7310	3.8639174	7343	3.8658735	7376	3.8678209
7311	3.8639768	7344	3.8659327	7377	3.8678798
7312	3.8640362	7345	3.8659918	7378	3.8679386
7313	3.8640956	7346	3.8660509	7379	3.8679975
7314	3.8641550	7347	3.8661100	7380	3.8680564
7315	3.8642143	7348	3.8661691	7381	3.8681152
7316	3.8642737	7349	3.8662282	7382	3.8681740
7317	3.8643331	7350	3.8662873	7383	3.8682329
7318	3.8643924	7351	3.8663464	7384	3.8682917
7319	3.8644517	7352	3.8664055	7385	3.8683505
7320	3.8645111	7353	3.8664646	7386	3.8684093
7321	3.8645704	7354	3.8665236	7387	3.8684681
7322	3.8646297	7355	3.8665827	7388	3.8685269
7323	3.8646890	7356	3.8666417	7389	3.8685857
7324	3.8647483	7357	3.8667008	7390	3.8686444
7325	3.8648076	7358	3.8667598	7391	3.8687032
7326	3.8648669	7359	3.8668188	7392	3.8687620
7327	3.8649262	7360	3.8668778	7393	3.8688207
7328	3.8649855	7361	3.8669368	7394	3.8688794
7329	3.8650447	7362	3.8669958	7395	3.8689382
7330	3.8651040	7363	3.8670548	7396	3.8689969
7331	3.8651632	7364	3.8671138	7397	3.8690556
7332	3.8652225	7365	3.8671728	7398	3.8691143
7333	3.8652817	7366	3.8672317	7399	3.8691730
7334	3.8653409	7367	3.8672907	7400	3.8692317

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7402	3.8693491	7435	3.8712810	7468	3.8732043
7403	3.8694077	7436	3.8713394	7469	3.8732625
7404	3.8694664	7437	3.8713978	7470	3.8733206
7405	3.8695251	7438	3.8714562	7471	3.8733787
7406	3.8695837	7439	3.8715146	7472	3.8734369
7407	3.8696423	7440	3.8715729	7473	3.8734950
7408	3.8697010	7441	3.8716313	7474	3.8735531
7409	3.8697596	7442	3.8716897	7475	3.8736112
7410	3.8698182	7443	3.8717480	7476	3.8736693
7411	3.8698768	7444	3.8718064	7477	3.8737274
7412	3.8699354	7445	3.8718647	7478	3.8737855
7413	3.8699940	7446	3.8719230	7479	3.8738435
7414	3.8700526	7447	3.8719814	7480	3.8739016
7415	3.8701112	7448	3.8720397	7481	3.8739597
7416	3.8701697	7449	3.8720980	7482	3.8740177
7417	3.8702283	7450	3.8721563	7483	3.8740757
7418	3.8702868	7451	3.8722146	7484	3.8741338
7419	3.8703454	7452	3.8722728	7485	3.8741918
7420	3.8704039	7453	3.8723311	7486	3.8742498
7421	3.8704624	7454	3.8723894	7487	3.8743078
7422	3.8705209	7455	3.8724476	7488	3.8743658
7423	3.8705795	7456	3.8725059	7489	3.8744238
7424	3.8706380	7457	3.8725641	7490	3.8744818
7425	3.8706965	7458	3.8726224	7491	3.8745398
7426	3.8707549	7459	3.8726806	7492	3.8745978
7427	3.8708134	7460	3.8727388	7493	3.8746557
7428	3.8708719	7461	3.8727970	7494	3.8747137
7429	3.8709304	7462	3.8728552	7495	3.8747716
7430	3.8709888	7463	3.8729134	7496	3.8748296
7431	3.8710473	7464	3.8729716	7497	3.8748875
7432	3.8711057	7465	3.8730298	7498	3.8749454
7433	3.8711641	7466	3.8730880	7499	3.8750034
7434	3.8712226	7467	3.8731462	7500	3.8750613

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7502	3.8751771	7535	3.8770833	7568	3.8789811
7503	3.8752349	7536	3.8771409	7569	3.8790385
7504	3.8752928	7537	3.8771985	7570	3.8790959
7505	3.8753507	7538	3.8772561	7571	3.8791532
7506	3.8754086	7539	3.8773137	7572	3.8792106
7507	3.8754664	7540	3.8773713	7573	3.8792680
7508	3.8755243	7541	3.8774289	7574	3.8793253
7509	3.8755821	7542	3.8774865	7575	3.8793826
7510	3.8756399	7543	3.8775441	7576	3.8794400
7511	3.8756978	7544	3.8776017	7577	3.8794973
7512	3.8757556	7545	3.8776592	7578	3.8795546
7513	3.8758134	7546	3.8777168	7579	3.8796119
7514	3.8758712	7547	3.8777743	7580	3.8796692
7515	3.8759290	7548	3.8778319	7581	3.8797265
7516	3.8759868	7549	3.8778894	7582	3.8797838
7517	3.8760445	7550	3.8779469	7583	3.8798411
7518	3.8761023	7551	3.8780045	7584	3.8798983
7519	3.8761601	7552	3.8780620	7585	3.8799556
7520	3.8762178	7553	3.8781195	7586	3.8800128
7521	3.8762756	7554	3.8781770	7587	3.8800701
7522	3.8763333	7555	3.8782345	7588	3.8801273
7523	3.8763911	7556	3.8782919	7589	3.8801846
7524	3.8764488	7557	3.8783494	7590	3.8802418
7525	3.8765065	7558	3.8784069	7591	3.8802990
7526	3.8765642	7559	3.8784643	7592	3.8803562
7527	3.8766219	7560	3.8785218	7593	3.8804134
7528	3.8766796	7561	3.8785792	7594	3.8804706
7529	3.8767373	7562	3.8786367	7595	3.8805278
7530	3.8767950	7563	3.8786941	7596	3.8805850
7531	3.8768526	7564	3.8787515	7597	3.8806421
7532	3.8769103	7565	3.8788089	7598	3.8806993
7533	3.8769680	7566	3.8788663	7599	3.8807564
7534	3.8770256	7567	3.8789237	7600	3.8808136

N.	Logarith.	N.	Logarith.	N.	Logarith.
7601	3.8808707	7634	3.8827522	7667	3.8846255
7602	3.8809279	7635	3.8828090	7668	3.8846821
7603	3.8809850	7636	3.8828659	7669	3.8847387
7604	3.8810421	7637	3.8829228	7670	3.8847954
7605	3.8810992	7638	3.8829797	7671	3.8848520
7606	3.8811563	7639	3.8830365	7672	3.8849086
7607	3.8812134	7640	3.8830934	7673	3.8849652
7608	3.8812705	7641	3.8831502	7674	3.8850218
7609	3.8813276	7642	3.8832070	7675	3.8850784
7610	3.8813847	7643	3.8832639	7676	3.8851350
7611	3.8814417	7644	3.8833207	7677	3.8851915
7612	3.8814988	7645	3.8833775	7678	3.8852481
7613	3.8815558	7646	3.8834343	7679	3.8853047
7614	3.8816129	7647	3.8834911	7680	3.8853612
7615	3.8816699	7648	3.8835479	7681	3.8854178
7616	3.8817269	7649	3.8836047	7682	3.8854743
7617	3.8817840	7650	3.8836614	7683	3.8855308
7618	3.8818410	7651	3.8837182	7684	3.8855874
7619	3.8818980	7652	3.8837750	7685	3.8856439
7620	3.8819550	7653	3.8838317	7686	3.8857004
7621	3.8820120	7654	3.8838885	7687	3.8857569
7622	3.8820689	7655	3.8839452	7688	3.8858134
7623	3.8821259	7656	3.8840019	7689	3.8858699
7624	3.8821829	7657	3.8840586	7690	3.8859263
7625	3.8822398	7658	3.8841154	7691	3.8859828
7626	3.8822968	7659	3.8841721	7692	3.8860393
7627	3.8823537	7660	3.8842288	7693	3.8860957
7628	3.8824107	7661	3.8842855	7694	3.8861522
7629	3.8824676	7662	3.8843421	7695	3.8862086
7630	3.8825245	7663	3.8843988	7696	3 8862651
7631	3.8825815	7664	3.8844555	7697	3.8863215
7632	3.8826384	7665	3.8845122	7698	3.8863779
7633	3.8826953	7666	3.8845688	7699	3.8864343
7634	3.8827522	7667	3.8846255	7700	3.8864907

N.	Logarith.	N.	Logarith.	N.	Logarith.
7701	3.8865471	7734	3.8884042	7767	3.8902533
7702	3.8866035	7735	3.8884603	7768	3.8903092
7703	3.8866599	7736	3.8885165	7769	3.8903651
7704	3.8867163	7737	3.8885726	7770	3.8904210
7705	3.8867726	7738	3.8886287	7771	3.8904769
7706	3.8868290	7739	3.8886848	7772	3.8905328
7707	3.8868854	7740	3.8887410	7773	3.8905887
7708	3.8869417	7741	3.8887971	7774	3.8906445
7709	3.8869980	7742	3.8888532	7775	3.8907004
7710	3.8870544	7743	3.8889093	7776	3.8907563
7711	3.8871107	7744	3.8889653	7777	3.8908121
7712	3.8871670	7745	3.8890214	7778	3.8908679
7713	3.8872233	7746	3.8890775	7779	3.8909238
7714	3.8872796	7747	3.8891336	7780	3.8909796
7715	3.8873359	7748	3.8891896	7781	3.8910354
7716	3.8873922	7749	3.8892457	7782	3.8910912
7717	3.8874485	7750	3.8893017	7783	3.8911470
7718	3.8875048	7751	3.8893577	7784	3.8912028
7719	3.8875610	7752	3.8894138	7785	3.8912586
7720	3.8876173	7753	3.8894698	7786	3.8913144
7721	3.8876736	7754	3.8895258	7787	3.8913702
7722	3.8877298	7755	3.8895818	7788	3.8914259
7723	3.8877860	7756	3.8896378	7789	3.8914817
7724	3.8878423	7757	3.8896938	7790	3.8915375
7725	3.8878985	7758	3.8897498	7791	3.8915932
7726	3.8879547	7759	3.8898058	7792	3.8916489
7727	3.8880109	7760	3.8898617	7793	3.8917047
7728	3.8880671	7761	3.8899177	7794	3.8917604
7729	3.8881233	7762	3.8899736	7795	3.8918161
7730	3.8881795	7763	3.8900296	7796	3.8918718
7731	3.8882357	7764	3.8900855	7797	3.8919275
7732	3.8882918	7765	3.8901415	7798	3.8919832
7733	3.8883480	7766	3.8901974	7799	3.8920389
7734	3.8884042	7767	3.8902533	7800	3.8920946

N.	Logarith.	N.	Logarith.	N.	Logarith.
7801	3.8921503	7834	3.8939836	7867	3.8958092
7802	3.8922059	7835	3.8940390	7868	3.8958644
7803	3.8922616	7836	3.8940944	7869	3.8959195
7804	3.8923173	7837	3.8941498	7870	3.8959747
7805	3.8923729	7838	3.8942053	7871	3.8960299
7806	3.8924285	7839	3.8942607	7872	3.8960851
7807	3.8924842	7840	3.8943161	7873	3.8961403
7808	3.8925398	7841	3.8943715	7874	3.8961954
7809	3.8925954	7842	3.8944268	7875	3.8962506
7810	3.8926510	7843	3.8944822	7876	3.8963057
7811	3.8927066	7844	3.8945376	7877	3.8963608
7812	3.8927622	7845	3.8945929	7878	3.8964160
7813	3.8928178	7846	3.8946483	7879	3.8964711
7814	3.8928734	7847	3.8947037	7880	3.8965262
7815	3.8929290	7848	3.8947590	7881	3.8965813
7816	3.8929845	7849	3.8948143	7882	3.8966364
7817	3.8930401	7850	3.8948697	7883	3.8966915
7818	3.8930957	7851	3.8949250	7884	3.8967466
7819	3.8931512	7852	3.8949803	7885	3.8968017
7820	3.8932068	7853	3.8950356	7886	3.8968568
7821	3.8932623	7854	3.8950909	7887	3.8969118
7822	3.8933178	7855	3.8951462	7888	3.8969669
7823	3.8933733	7856	3.8952015	7889	3.8970220
7824	3.8934288	7857	3.8952568	7890	3.8970770
7825	3.8934843	7858	3.8953120	7891	3.8971320
7826	3.8935398	7859	3.8953673	7892	3.8971871
7827	3.8935953	7860	3.8954225	7893	3.8972421
7828	3.8936508	7861	3.8954778	7894	3.8972971
7829	3.8937063	7862	3.8955330	7895	3.8973521
7830	3.8937618	7863	3.8955883	7896	3.8974071
7831	3.8938172	7864	3.8956435	7897	3.8974621
7832	3.8938727	7865	3.8956987	7898	3.8975171
7833	3.8939281	7866	3.8957539	7899	3.8975721
7834	3.8939836	7867	3.8958092	7900	3.8976271

N.	Logarith.	N.	Logarith.	N.	Logarith.
7901	3.8976821	7934	3.8994922	7967	3.9012948
7902	3.8977370	7935	3.8995469	7968	3.9013493
7903	3.8977920	7936	3.8996017	7969	3.9014038
7904	3.8978469	7937	3.8996564	7970	3.9014583
7905	3.8979019	7938	3.8997111	7971	3.9015128
7906	3.8979568	7939	3.8997658	7972	3.9015673
7907	3.8980117	7940	3.8998205	7973	3.9016218
7908	3.8980667	7941	3.8998752	7974	3.9016762
7909	3.8981216	7942	3.8999299	7975	3.9017307
7910	3.8981765	7943	3.8999846	7976	3.9017851
7911	3.8982314	7944	3.9000392	7977	3.9018396
7912	3.8982863	7945	3.9000939	7978	3.9018940
7913	3.8983412	7946	3.9001486	7979	3.9019485
7914	3.8983960	7947	3.9002032	7980	3.9020029
7915	3.8984509	7948	3.9002579	7981	3.9020573
7916	3.8985058	7949	3.9003125	7982	3.9021117
7917	3.8985606	7950	3.9003671	7983	3.9021661
7918	3.8986155	7951	3.9004218	7984	3.9022205
7919	3.8986703	7952	3.9004764	7985	3.9022749
7920	3.8987252	7953	3.9005310	7986	3.9023293
7921	3.8987800	7954	3.9005856	7987	3.9023837
7922	3.8988348	7955	3.9006402	7988	3.9024381
7923	3.8988897	7956	3.9006948	7989	3.9024924
7924	3.8989445	7957	3.9007494	7990	3.9025468
7925	3.8989993	7958	3.9008039	7991	3.9026011
7926	3.8990541	7959	3.9008585	7992	3.9026555
7927	3.8991089	7960	3.9009131	7993	3.9027098
7928	3.8991636	7961	3.9009676	7994	3.9027641
7929	3.8992184	7962	3.9010222	7995	3.9028185
7930	3.8992732	7963	3.9010767	7996	3.9028728
7931	3.8993279	7964	3.9011313	7997	3.9029271
7932	3.8993827	7965	3.9011858	7998	3.9029814
7933	3.8994375	7966	3.9012403	7999	3.9030357
7934	3.8994922	7967	3.9012948	8000	3.9030900

N.	Logarith.	N.	Logarith.	N.	Logarith.
8001	3.9031443	8034	3.9049318	8067	3.9067121
8002	3.9031985	8035	3.9049859	8068	3.9067659
8003	3.9032528	8036	3.9050399	8069	3.9068197
8004	3.9033071	8037	3.9050940	8070	3.9068735
8005	3.9033613	8038	3.9051480	8071	3.9069273
8006	3.9034156	8039	3.9052020	8072	3.9069812
8007	3.9034698	8040	3.9052560	8073	3.9070350
8008	3.9035241	8041	3.9053101	8074	3.9070887
8009	3.9035783	8042	3.9053641	8075	3.9071425
8010	3.9036325	8043	3.9054181	8076	3.9071963
8011	3.9036867	8044	3.9054721	8077	3.9072501
8012	3.9037409	8045	3.9055260	8078	3.9073038
8013	3.9037951	8046	3.9055800	8079	3.9073576
8014	3.9038493	8047	3.9056340	8080	3.9074114
8015	3.9039035	8048	3.9056880	8081	3.9074651
8016	3.9039577	8049	3.9057419	8082	3.9075188
8017	3.9040119	8050	3.9057959	8083	3.9075726
8018	3.9040661	8051	3.9058498	8084	3.9076263
8019	3.9041202	8052	3.9059038	8085	3.9076800
8020	3.9041744	8053	3.9059577	8086	3.9077337
8021	3.9042285	8054	3.9060116	8087	3.9077874
8022	3.9042827	8055	3.9060655	8088	3.9078411
8023	3.9043368	8056	3.9061195	8089	3.9078948
8024	3.9043909	8057	3.9061734	8090	3.9079485
8025	3.9044450	8058	3.9062273	8091	3.9080022
8026	3.9044992	8059	3.9062812	8092	3.9080559
8027	3.9045533	8060	3.9063350	8093	3.9081095
8028	3.9046074	8061	3.9063889	8094	3.9081632
8029	3.9046615	8062	3.9064428	8095	3.9082169
8030	3.9047155	8063	3.9064967	8096	3.9082705
8031	3.9047696	8064	3.9065505	8097	3.9083241
8032	3.9048237	8065	3.9066044	8098	3.9083778
8033	3.9048778	8066	3.9066582	8099	3.9084314
8034	3.9049318	8067	3.9067121	8100	3.9084850

N.	Logarith.	N.	Logarith.	N.	Logarith.
8101	3.9085386	8134	3.9103042	8167	3.9120626
8102	3.9085922	8135	3.9103576	8168	3.9121157
8103	3.9086458	8136	3.9104109	8169	3.9121689
8104	3.9086994	8137	3.9104643	8170	3.9122221
8105	3.9087530	8138	3.9105177	8171	3.9122752
8106	3.9088066	8139	3.9105710	8172	3.9123284
8107	3.9088602	8140	3.9106244	8173	3.9123815
8108	3.9089137	8141	3.9106778	8174	3.9124346
8109	3.9089673	8142	3.9107311	8175	3.9124878
8110	3.9090209	8143	3.9107844	8176	3.9125409
8111	3.9090744	8144	3.9108378	8177	3.9125940
8112	3.9091279	8145	3.9108911	8178	3.9126471
8113	3.9091815	8146	3.9109444	8179	3.9127002
8114	3.9092350	8147	3.9109977	8180	3.9127533
8115	3.9092885	8148	3.9110510	8181	3.9128064
8116	3.9093420	8149	3.9111043	8182	3.9128595
8117	3.9093955	8150	3.9111576	8183	3.9129126
8118	3.9094490	8151	3.9112109	8184	3.9129656
8119	3.9095025	8152	3.9112642	8185	3.9130187
8120	3.9095560	8153	3.9113174	8186	3.9130717
8121	3.9096095	8154	3.9113707	8187	3.9131248
8122	3.9096630	8155	3.9114240	8188	3.9131778
8123	3.9097165	8156	3.9114772	8189	3.9132309
8124	3.9097699	8157	3.9115305	8190	3.9132839
8125	3.9098234	8158	3.9115837	8191	3.9133369
8126	3.9098768	8159	3.9116369	8192	3.9133899
8127	3.9099303	8160	3.9116902	8193	3.9134430
8128	3.9099837	8161	3.9117434	8194	3.9134960
8129	3.9100371	8162	3.9117966	8195	3.9135490
8130	3.9100905	8163	3.9118498	8196	3.9136019
8131	3.9101440	8164	3.9119030	8197	3.9136549
8132	3.9101974	8165	3.9119562	8198	3.9137079
8133	3.9102508	8166	3.9120094	8199	3.9137609
8134	3.9103042	8167	3.9120626	8200	3.9138139

N.	Logarith.	N.	Logarith.	N.	Logarith.
8201	3.9138668	8234	3.9156109	8267	3.9173479
8202	3.9139198	8235	3.9156636	8268	3.9174005
8203	3.9139727	8236	3.9157163	8269	3.9174530
8204	3.9140256	8237	3.9157691	8270	3.9175055
8205	3.9140786	8238	3.9158218	8271	3.9175580
8206	3.9141315	8239	3.9158745	8272	3.9176105
8207	3.9141844	8240	3.9159272	8273	3.9176630
8208	3.9142373	8241	3.9159799	8274	3.9177155
8209	3.9142903	8242	3.9160326	8275	3.9177680
8210	3.9143432	8243	3.9160853	8276	3.9178205
8211	3.9143961	8244	3.9161380	8277	3.9178730
8212	3.9144489	8245	3.9161907	8278	3.9179254
8213	3.9145018	8246	3.9162433	8279	3.9179779
8214	3.9145547	8247	3.9162960	8280	3.9180303
8215	3.9146076	8248	3.9163487	8281	3.9180828
8216	3.9146604	8249	3.9164013	8282	3.9181352
8217	3.9147133	8250	3.9164539	8283	3.9181877
8218	3.9147661	8251	3.9165066	8284	3.9182401
8219	3.9148190	8252	3.9165592	8285	3.9182925
8220	3.9148718	8253	3.9166118	8286	3.9183449
8221	3.9149246	8254	3.9166645	8287	3.9183973
8222	3.9149775	8255	3.9167171	8288	3.9184497
8223	3.9150303	8256	3.9167697	8289	3.9185021
8224	3.9150831	8257	3.9168223	8290	3.9185545
8225	3.9151359	8258	3.9168749	8291	3.9186069
8226	3.9151887	8259	3.9169275	8292	3.9186593
8227	3.9152415	8260	3.9169800	8293	3.9187117
8228	3.9152943	8261	3.9170326	8294	3.9187640
8229	3.9153471	8262	3.9170852	8295	3.9188164
8230	3.9153998	8263	3.9171378	8296	3.9188687
8231	3.9154526	8264	3.9171903	8297	3.9189211
8232	3.9155054	8265	3.9172429	8298	3.9189734
8233	3.9155581	8266	3.9172954	8299	3.9190258
8234	3.9156109	8267	3.9173479	8300	3.9190781

N.	Logarith.	N.	Logarith.	N.	Logarith.
8301	3.9191304	8334	3.9208535	8367	3.9225698
8302	3.9191827	8335	3.9209056	8368	3.9226217
8303	3 9192350	8336	3.9209577	8369	3.9226736
8304	3.9192873	8337	3.9210098	8370	3.9227255
8305	3.9193396	8338	3.9210619	8371	3.9227773
8306	3.9193919	8339	3.9211140	8372	3.9228292
8307	3.9194442	8340	3.9211661	8373	3.9228811
8308	3.9194965	8341	3.9212181	8374	3.9229330
8309	3.9195488	8342	3.9212702	8375	3.9229848
8310	3.9196010	8343	3.9213222	8376	3.9230367
8311	3.9196533	8344	3.9213743	8377	3.9230885
8312	3.9197055	8345	3.9214263	8378	3.9231404
8313	3.9197578	8346	3.9214784	8379	3.9231922
8314	3.9198100	8347	3.9215304	8380	3.9232440
8315	3.9198623	8348	3.9215824	8381	3.9232958
8316	3.9199145	8349	3.9216345	8382	3.9233477
8317	3.9199667	8350	3.9216865	8383	3.9233995
8318	3.9200189	8351	3.9217385	8384	3.9234513
8319	3.9200711	8352	3.9217905	8385	3.9235031
8320	3.9201233	8353	3.9218425	8386	3.9235549
8321	3.9201755	8354	3.9218945	8387	3.9236066
8322	3.9202277	8355	3.9219465	8388	3.9236584
8323	3.9202799	8356	3.9219984	8389	3.9237102
8324	3.9203321	8357	3.9220504	8390	3.9237620
8325	3.9203842	8358	3.9221024	8391	3.9238137
8326	3.9204364	8359	3.9221543	8392	3.9238655
8327	3.9204886	8360	3.9222063	8393	3.9239172
8328	3.9205407	8361	3.9222582	8394	3.9239690
8329	3.9205929	8362	3.9223102	8395	3.9240207
8330	3.9206450	8363	3.9223621	8396	3.9240724
8331	3.9206971	8364	3.9224140	8397	3.9241242
8332	3.9207493	8365	3.9224659	8398	3.9241759
8333	3.9208014	8366	3.9225179	8399	3.9242276
8334	3.9208535	8367	3.9225698	8400	3.9242793

N.	Logarith.	N.	Logarith.	N.	Logarith.
8401	3.9243310	8434	3.9260336	8467	3.9277296
8402	3.9243827	8435	3.9260851	8468	3.9277808
8403	3.9244344	8436	3.9261366	8469	3.9278321
8404	3.9244860	8437	3.9261880	8470	3.9278834
8405	3.9245377	8438	3.9262395	8471	3.9279347
8406	3.9245894	8439	3.9262910	8472	3.9279859
8407	3.9246410	8440	3.9263424	8473	3.9280372
8408	3.9246927	8441	3.9263939	8474	3.9280885
8409	3.9247444	8442	3.9264453	8475	3.9281397
8410	3.9247960	8443	3.9264968	8476	3.9281909
8411	3.9248476	8444	3.9265482	8477	3.9282422
8412	3.9248993	8445	3.9265997	8478	3.9282934
8413	3.9249509	8446	3.9266511	8479	3.9283446
8414	3.9250025	8447	3.9267025	8480	3.9283959
8415	3.9250541	8448	3.9267539	8481	3.9284471
8416	3.9251057	8449	3.9268053	8482	3.9284983
8417	3.9251573	8450	3.9268567	8483	3.9285495
8418	3.9252089	8451	3.9269081	8484	3.9286007
8419	3.9252605	8452	3.9269595	8485	3.9286518
8420	3.9253121	8453	3.9270109	8486	3.9287030
8421	3.9253637	8454	3.9270622	8487	3.9287542
8422	3.9254152	8455	3.9271136	8488	3.9288054
8423	3.9254668	8456	3.9271650	8489	3.9288565
8424	3.9255184	8457	3.9272163	8490	3.9289077
8425	3.9255699	8458	3.9272677	8491	3.9289588
8426	3.9256215	8459	3.9273190	8492	3.9290100
8427	3.9256730	8460	3.9273704	8493	3.9290611
8428	3.9257245	8461	3.9274217	8494	3.9291123
8429	3.9257761	8462	3.9274730	8495	3.9291634
8430	3.9258276	8463	3.9275243	8496	3.9292145
8431	3.9258791	8464	3.9275757	8497	3.9292656
8432	3.9259306	8465	3.9276270	8498	3.9293167
8433	3.9259821	8466	3.9276783	8499	3.9293678
8434	3.9260336	8467	3.9277296	8500	3.9294189

N.	Logarith.	N.	Logarith.	N.	Logarith.
8501	3.9294700	8534	3.9311526	8567	3.9328288
8502	3.9295211	8535	3.9312035	8568	3.9328795
8503	3.9295722	8536	3.9312544	8569	3.9329301
8504	3.9296232	8537	3.9313035	8570	3.9339808
8505	3.9296743	8538	3.9313561	8571	3.9330315
8506	3.9297254	8539	3.9314070	8572	3.9330822
8507	3.9297764	8540	3.9314579	8573	3.9331328
8508	3.9298275	8541	3.9315087	8574	3.9331835
8509	3.9298785	8542	3.9315596	8575	3.9332341
8510	3.9299296	8543	3.9316104	8576	3.9332848
8511	3.9299806	8544	3.9316612	8577	3.9333354
8512	3.9300316	8545	3.9317121	8578	3.9333860
8513	3.9300826	8546	3.9317629	8579	3.9334367
8514	3.9301336	8547	3.9318137	8580	3.9334873
8515	3.9301847	8548	3.9318645	8581	3.9335379
8516	3.9302357	8549	3.9319153	8582	3.9335885
8517	3.9302866	8550	3.9319661	8583	3.9336391
8518	3.9303376	8551	3.9320169	8584	3.9336897
8519	3.9303886	8552	3.9320677	8585	3.9337403
8520	3.9304396	8553	3.9321185	8586	3.9337909
8521	3.9304906	8554	3.9321692	8587	3.9338415
8522	3.9305415	8555	3.9322200	8588	3.9338920
8523	3.9305925	8556	3.9322708	8589	3.9339426
8524	3.9306434	8557	3.9323215	8590	3.9339932
8525	3.9306944	8558	3.9323723	8591	3.9340437
8526	3.9307453	8559	3.9324230	8592	3.9340943
8527	3.9307963	8560	3.9324738	8593	3.9341448
8528	3.9308472	8561	3.9325245	8594	3.9341953
8529	3.9308981	8562	3.9325752	8595	3.9342459
8530	3.9309490	8563	3.9326259	8596	3.9342964
8531	3.9309999	8564	3.9326767	8597	3.9343469
8532	3.9310508	8565	3.9327274	8598	3.9343974
8533	3.9311017	8566	3.9327781	8599	3.9344479
8534	3.9311526	8567	3.9328288	8600	3.9344984

N.	Logarith.	N.	Logarith.	N.	Logarith.
8601	3.9345489	8634	3.9362120	8667	3.9378688
8602	3.9345994	8635	3.9362623	8668	3.9379189
8603	3.9346499	8636	3.9363126	8669	3.9379690
8604	3.9347004	8637	3.9363629	8670	3.9380191
8605	3.9347509	8638	3.9364132	8671	3.9380692
8606	3.9348013	8639	3.9364635	8672	3.9381193
8607	3.9348518	8640	3.9365137	8673	3.9381693
8608	3.9349023	8641	3.9365640	8674	3.9382194
8609	3.9349527	8642	3.9366143	8675	3.9382695
8610	3.9350032	8643	3.9366645	8676	3.9383195
8611	3.9350536	8644	3.9367148	8677	3.9383696
8612	3.9351040	8645	3.9367650	8678	3.9384196
8613	3.9351544	8646	3.9368152	8679	3.9384697
8614	3.9352049	8647	3.9368655	8680	3.9385197
8615	3.9352553	8648	3.9369157	8681	3.9385698
8616	3.9353057	8649	3.9369659	8682	3.9386198
8617	3.9353561	8650	3.9370161	8683	3.9386698
8618	3.9354065	8651	3.9370663	8684	3.9387198
8619	3.9354569	8652	3.9371165	8685	3.9387698
8620	3.9355073	8653	3.9371667	8686	3.9388198
8621	3.9355576	8654	3.9372169	8687	3.9388698
8622	3 9356080	8655	3.9372671	8688	3.9389193
8623	3.9356584	8656	3.9373172	8689	3.9389698
8624	3.9357087	8657	3.9373674	8690	3.9390198
8625	3.9357591	8658	3.9374176	8691	3.9390697
8626	3.9358095	8659	3.9374677	8692	3.9391197
8627	3.9358598	8660	3.9375179	8693	3.9391697
8628	3.9359101	8661	3.9375680	8694	3.9392196
8629	3.9359605	8662	3.9376182	8695	3.9392696
8630	3.9360108	8663	3.9376683	8696	3.9393195
8631	3.9360611	8664	3.9377184	8697	3.9393695
8632	3.9361114	8665	3.9377686	8698	3.9394194
8633	3.9361617	8666	3.9378187	8699	3.9394693
8634	3.9362120	8667	3.9378688	8700	3.9395193

N.	Logarith.	N.	Logarith.	N.	Logarith.
8701	3.9395692	8734	3.9412132	8767	3.9428510
8702	3.9396191	8735	3.9412629	8768	3.9429005
8703	3.9396690	8736	3.9413126	8769	3.9429501
8704	3.9397189	8737	3.9413623	8770	3.9429996
8705	3.9397688	8738	3.9414120	8771	3.9430491
8706	3.9398187	8739	3.9414617	8772	3.9430986
8707	3.9398685	8740	3.9415114	8773	3.9431481
8708	3.9399184	8741	3.9415611	8774	3.9431976
8709	3.9399683	8742	3.9416108	8775	3.9432471
8710	3.9400182	8743	3.9416605	8776	3.9432966
8711	3.9400680	8744	3.9417101	8777	3.9433461
8712	3.9401179	8745	3.9417598	8778	3.9433956
8713	3.9401677	8746	3.9418095	8779	3.9434450
8714	3.9402176	8747	3.9418591	8780	3.9434945
8715	3.9402674	8748	3.9419088	8781	3.9435440
8716	3.9403172	8749	3.9419584	8782	3.9435934
8717	3.9403670	8750	3.9420081	8783	3.9436429
8718	3.9404169	8751	3.9420577	8784	3.9436923
8719	3.9404667	8752	3.9421073	8785	3.9437418
8720	3.9405165	8753	3.9421569	8786	3.9437912
8721	3.9405663	8754	3.9422065	8787	3.9438406
8722	3.9406161	8755	3.9422561	8788	3.9438900
8723	3.9406659	8756	3.9423058	8789	3.9439395
8724	3.9407157	8757	3.9423553	8790	3.9439889
8725	3.9407654	8758	3.9424049	8791	3.9440383
8726	3.9408152	8759	3.9424545	8792	3.9440877
8727	3.9408650	8760	3.9425041	8793	3.9441371
8728	3.9409147	8761	3.9425537	8794	3.9441865
8729	3.9409645	8762	3.9426032	8795	3.9442358
8730	3.9410142	8763	3.9426528	8796	3.9442852
8731	3.9410640	8764	3.9427024	8797	3.9443346
8732	3.9411137	8765	3.9427519	8798	3.9443840
8733	3.9411635	8766	3.9428015	8799	3.9444333
8734	3.9412132	8767	3.9428510	8800	3.9444827

N.	Logarith.	N.	Logarith.	N.	Logarith.
8801	3.9445320	8834	3.9461574	8867	3.9477767
8802	3.9445814	8835	3.9462066	8868	3.9478257
8803	3.9446307	8836	3.9462557	8869	3.9478747
8804	3.9446800	8837	3.9463049	8870	3.9479236
8805	3.9447294	8838	3.9463540	8871	3.9479726
8806	3.9447787	8839	3.9464031	8872	3.9480215
8807	3.9448280	8840	3.9464523	8873	3.9480705
8808	3.9448773	8841	3.9465014	8874	3.9481194
8809	3.9449266	8842	3.9465505	8875	3.9481684
8810	3.9449759	8843	3.9465996	8876	3.9482173
8811	3.9450252	8844	3.9466487	8877	3.9482662
8812	3.9450745	8845	3.9466978	8878	3.9483151
8813	3.9451238	8846	3.9467469	8879	3.9483641
8814	3.9451730	8847	3.9467960	8880	3.9484130
8815	3.9452223	8848	3.9468451	8881	3.9484619
8816	3.9452716	8849	3.9468942	8882	3.9485108
8817	3.9453208	8850	3.9469433	8883	3.9485597
8818	3.9453701	8851	3.9469923	8884	3.9486085
8819	3.9454193	8852	3.9470414	8885	3.9486574
8820	3.9454686	8853	3.9470905	8886	3.9487063
8821	3.9455178	8854	3.9471395	8887	3.9487552
8822	3.9455671	8855	3.9471886	8888	3.9488040
8823	3.9456163	8856	3.9472376	8889	3.9488529
8824	3.9456655	8857	3.9472866	8890	3.9489018
8825	3.9457147	8858	3.9473357	8891	3.9489506
8826	3.9457639	8859	3.9473847	8892	3.9489995
8827	3.9458131	8860	3.9474337	8893	3.9490483
8828	3.9458623	8861	3.9474827	8894	3.9490971
8829	3.9459115	8862	3.9475317	8895	3.9491460
8830	3.9459607	8863	3.9475807	8896	3.9491948
8831	3.9460099	8864	3.9476297	8897	3.9492436
8832	3.9460591	8865	3.9476787	8898	3.9492924
8833	3.9461082	8866	3.9477277	8899	3.9493413
8834	3.9461574	8867	3.9477767	8900	3.9493900

N.	Logarith.	N.	Logarith.	N.	Logarith.
8901	3.9494388	8934	3.9510459	8967	3.9526472
8902	3.9494876	8935	3.9510946	8968	3.9526966
8903	3.9495364	8936	3.9511432	8969	3.9527440
8904	3.9495852	8937	3.9511918	8970	3.9527924
8905	3.9496339	8938	3.9512404	8971	3.9528409
8906	3.9496827	8939	3.9512889	8972	3.9528893
8907	3.9497315	8940	3.9513375	8973	3.9529377
8908	3.9497802	8941	3.9513861	8974	3.9529861
8909	3.9498290	8942	3.9514347	8975	3.9530345
8910	3.9498777	8943	3.9514832	8976	3.9530828
8911	3.9499264	8944	3.9515318	8977	3.9531312
8912	3.9499752	8945	3.9515803	8978	3.9531796
8913	3.9500239	8946	3.9516289	8979	3.9532280
8914	3.9500726	8947	3.9516774	8980	3.9532763
8915	3.9501213	8948	3.9517260	8981	3.9533247
8916	3.9501701	8949	3.9517745	8982	3.9533730
8917	3.9502188	8950	3.9518230	8983	3.9534214
8918	3.9502675	8951	3.9518716	8984	3.9534697
8919	3.9503162	8952	3.9519201	8985	3.9535181
8920	3.9503649	8953	3.9519686	8986	3.9535664
8921	3.9504135	8954	3.9520171	8987	3.9536147
8922	3.9504622	8955	3.9520656	8988	3.9536631
8923	3.9505109	8956	3.9521141	8989	3.9537114
8924	3.9505596	8957	3.9521626	8990	3.9537597
8925	3.9506082	8958	3.9522111	8991	3.9538080
8926	3.9506569	8959	3.9522595	8992	3.9538563
8927	3.9507055	8960	3.9523080	8993	3.9539046
8928	3.9507542	8961	3.9523565	8994	3.9539529
8929	3.9508028	8962	3.9524049	8995	3.9540012
8930	3.9508515	8963	3.9524534	8996	3.9540494
8931	3.9509001	8964	3.9525018	8997	3.9540977
8932	3.9509487	8965	3.9525503	8998	3.9541460
8933	3.9509973	8966	3.9525987	8999	3.9541943
8934	3.9510459	8967	3.9526472	9000	3.9542425

N.	Logarith.	N.	Logarith.	N.	Logarith.
9001	3.9542908	9034	3.9558801	9067	3.9574636
9002	3.9543390	9035	3.9559282	9068	3.9575115
9003	3.9543872	9036	3.9559762	9069	3.9575594
9004	3.9544355	9037	3.9560243	9070	3.9576073
9005	3.9544837	9038	3.9560723	9071	3.9576552
9006	3.9545319	9039	3.9561204	9072	3.9577030
9007	3.9545802	9040	3.9561684	9073	3.9577509
9008	3.9546284	9041	3.9562165	9074	3.9577988
9009	3.9546766	9042	3.9562645	9075	3.9578466
9010	3.9547248	9043	3.9563125	9076	3.9578945
9011	3.9547730	9044	3.9563606	9077	3.9579423
9012	3.9548212	9045	3.9564086	9078	3.9579902
9013	3.9548694	9046	3.9564566	9079	3.9580380
9014	3.9549176	9047	3.9565046	9080	3.9580858
9015	3.9549657	9048	3.9565526	9081	3.9581337
9016	3.9550139	9049	3.9566006	9082	3.9581815
9017	3.9550621	9050	3.9566486	9083	3.9582293
9018	3.9551102	9051	3.9566966	9084	3.9582771
9019	3.9551584	9052	3.9567445	9085	3.9583249
9020	3.9552065	9053	3.9567925	9086	3.9583727
9021	3.9552547	9054	3.9568405	9087	3.9584205
9022	3.9553028	9055	3.9568885	9088	3.9584683
9023	3.9553510	9056	3.9569364	9089	3.9585161
9024	3.9553991	9057	3.9569844	9090	3.9585639
9025	3.9554472	9058	3.9570323	9091	3.9586117
9026	3.9554953	9059	3.9570803	9092	3.9586594
9027	3.9555434	9060	3.9571282	9093	3.9587072
9028	3.9555915	9061	3.9571761	9094	3.9587549
9029	3.9556397	9062	3.9572241	9095	3.9588027
9030	3.9556877	9063	3.9572720	9096	3.9588505
9031	3.9557358	9064	3.9573199	9097	3.9588982
9032	3.9557839	9065	3.9573678	9098	3.9589459
9033	3.9558320	9066	3.9574157	9099	3.9589937
9034	3.9558801	9067	3.9574636	9100	3.9590414

N.	Logarith.	N.	Logarith.	N.	Logarith.
9101	3.9590891	9134	3.9606610	9167	3.9622272
9102	3.9591368	9135	3.9607086	9168	3.9622746
9103	3.9591845	9136	3.9607561	9169	3.9623220
9104	3.9592322	9137	3.9608036	9170	3.9623693
9105	3.9592799	9138	3.9608512	9171	3.9624167
9106	3.9593276	9139	3.9608987	9172	3.9624640
9107	3.9593753	9140	3.9609462	9173	3.9625114
9108	3.9594230	9141	3.9609937	9174	3.9625587
9109	3.9594707	9142	3.9610412	9175	3.9626061
9110	3.9595184	9143	3.9610887	9176	3.9626534
9111	3.9595660	9144	3.9611362	9177	3.9627007
9112	3.9596137	9145	3.9611837	9178	3.9627481
9113	3.9596614	9146	3.9612312	9179	3.9627954
9114	3.9597090	9147	3.9612787	9180	3.9628427
9115	3.9597567	9148	3.9613262	9181	3.9628900
9116	3.9598043	9149	3.9613736	9182	3.9629373
9117	3.9598520	9150	3.9614211	9183	3.9629846
9118	3.9598996	9151	3.9614686	9184	3.9630319
9119	3.9599472	9152	3.9615160	9185	3.9630792
9120	3.9599948	9153	3.9615635	9186	3.9631264
9121	3.9600425	9154	3.9616109	9187	3.9631737
9122	3.9600901	9155	3.9616583	9188	3.9632210
9123	3.9601377	9156	3.9617058	9189	3.9632683
9124	3.9601853	9157	3.9617532	9190	3.9633155
9125	3.9602329	9158	3.9618006	9191	3.9633628
9126	3.9602805	9159	3.9618481	9192	3.9634100
9127	3.9603280	9160	3.9618955	9193	3.9634573
9128	3.9603756	9161	3.9619429	9194	3.9635045
9129	3.9604232	9162	3.9619903	9195	3.9635517
9130	3.9604708	9163	3.9620377	9196	3.9635990
9131	3.9605181	9164	3.9620851	9197	3.9636462
9132	3.9605659	9165	3.9621325	9198	3.9636934
9133	3.9606135	9166	3.9621799	9199	3.9637406
9134	3.9606610	9167	3.9622272	9200	3.9637878

N.	Logarith.	N.	Logarith.	N.	Logarith.
9201	3.9638350	9234	3.9653899	9267	3.9669392
9202	3.9638822	9235	3.9654369	9268	3.9669860
9203	3.9639294	9236	3.9654839	9269	3.9670329
9204	3.9639766	9237	3.9655309	9270	3.9670797
9205	3.9640238	9238	3.9655780	9271	3.9671266
9206	3.9640710	9239	3.9656250	9272	3.9671734
9207	3.9641181	9240	3.9656720	9273	3.9672203
9208	3.9641653	9241	3.9657190	9274	3.9672671
9209	3.9642125	9242	3.9657660	9275	3.9673139
9210	3.9642596	9243	3.9658130	9276	3.9673607
9211	3.9643068	9244	3.9658599	9277	3.9674076
9212	3.9643539	9245	3.9659069	9278	3.9674544
9213	3.9644011	9246	3.9659539	9279	3.9675012
9214	3.9644482	9247	3.9660009	9280	3.9675480
9215	3.9644953	9248	3.9660478	9281	3.9675948
9216	3.9645425	9249	3.9660948	9282	3.9676416
9217	3.9645896	9250	3.9661417	9283	3.9676883
9218	3.9646367	9251	3.9661887	9284	3.9677352
9219	3.9646838	9252	3.9662356	9285	3.9677810
9220	3.9647309	9253	3.9662826	9286	3.9678287
9221	3.9657780	9254	3.9663295	9287	3.9678754
9222	3 9658251	9255	3.9663764	9288	3.9679222
9223	3.9658722	9256	3.9664233	9289	3.9679690
9224	3.9659193	9257	3.9664703	9290	3.9680157
9225	3.9659664	9258	3.9665172	9291	3.9680625
9226	3.9650134	9259	3.9665641	9292	3.9681092
9227	3.9650605	9260	3.9666110	9293	3.9681559
9228	3.9651076	9261	3.9666579	9294	3.9682027
9229	3.9651546	9262	3.9667048	9295	3.9682494
9230	3.9652017	9263	3.9667517	9296	3.9682961
9231	3.9652488	9264	3.9667985	9297	3.9683428
9232	3.9652958	9265	3.9668454	9298	3.9683895
9233	3.9653428	9266	3.9668923	9299	3.9684362
9234	3.9653899	9267	3.9669392	9300	3.9684829

N.	Logarith.	N.	Logarith.	N.	Logarith.
9301	3.9685296	9334	3.9700678	9367	3.9716005
9302	3.9685763	9335	3.9701143	9368	3.9716469
9303	3.9686230	9336	3.9701608	9369	3.9716932
9304	3.9686697	9337	3.9702074	9370	3.9717396
9305	3.9687164	9338	3.9702539	9371	3.9717859
9306	3.9687630	9339	3.9703004	9372	3.9718323
9307	3.9688097	9340	3.9703469	9373	3.9718786
9308	3.9688564	9341	3.9703934	9374	3.9719249
9309	3.9689030	9342	3.9704399	9375	3.9719713
9310	3.9689497	9343	3.9704863	9376	3.9720176
9311	3.9689963	9344	3.9705328	9377	3.9720639
9312	3.9690430	9345	3.9705793	9378	3.9721102
9313	3.9690896	9346	3.9706258	9379	3.9721565
9314	3.9691362	9347	3.9706722	9380	3.9722028
9315	3.9691829	9348	3.9707187	9381	3.9722491
9316	3.9692295	9349	3.9707652	9382	3.9722954
9317	3.9692761	9350	3.9708116	9383	3.9723417
9318	3.9693227	9351	3.9708581	9384	3.9723880
9319	3.9693693	9352	3.9709045	9385	3.9724343
9320	3.9694159	9353	3.9709509	9386	3.9724805
9321	3.9694625	9354	3.9709974	9387	3.9725268
9322	3.9695091	9355	3.9710438	9388	3.9725731
9323	3.9695557	9356	3.9710902	9389	3.9726193
9324	3.9696023	9357	3.9711366	9390	3.9726656
9325	3.9696488	9358	3.9711830	9391	3.9727118
9326	3.9696954	9359	3.9712294	9392	3.9727581
9327	3.9697420	9360	3.9712758	9393	3.9728043
9328	3.9697885	9361	3.9713222	9394	3.9728506
9329	3.9698351	9362	3.9713686	9395	3 9728968
9330	3.9698816	9363	3.9714150	9396	3.9729430
9331	3.9699282	9364	3.9714614	9397	3.9729892
9332	3.9699747	9365	3.9715078	9398	3.9730354
9333	3.9700213	9366	3.9715542	9399	3.9730816
9334	3.9700678	9367	3.9716005	9400	3.9731279

N.	Logarith.	N.	Logarith.	N.	Logarith.
9401	3.9731741	9434	3.9746959	9467	3.9762124
9402	3.9732203	9435	3.9747419	9468	3.9762582
9403	3.9732664	9436	3.9747879	9469	3.9763041
9404	3.9733126	9437	3.9748340	9470	3.9763500
9405	3.9733588	9438	3.9748800	9471	3.9763958
9406	3.9734050	9439	3.9749260	9472	3.9764417
9407	3.9734511	9440	3.9749720	9473	3.9764875
9408	3.9734973	9441	3.9750180	9474	3.9765334
9409	3.9735435	9442	3.9750640	9475	3.9765792
9410	3.9735896	9443	3.9751100	9476	3.9766251
9411	3.9736358	9444	3.9751560	9477	3.9766709
9412	3.9736819	9445	3.9752020	9478	3.9767167
9413	3.9737281	9446	3.9752479	9479	3.9767625
9414	3.9737742	9447	3.9752939	9480	3.9768083
9415	3.9738203	9448	3.9753399	9481	3.9768541
9416	3.9738664	9449	3.9753858	9482	3.9768999
9417	3.9739126	9450	3.9754318	9483	3.9769457
9418	3.9739587	9451	3.9754778	9484	3.9769915
9419	3.9740048	9452	3.9755237	9485	3.9770373
9420	3.9740509	9453	3.9755697	9486	3.9770831
9421	3.9740970	9454	3.9756156	9487	3.9771289
9422	3.9741431	9455	3.9756615	9488	3.9771747
9423	3.9741892	9456	3.9757075	9489	3.9772204
9424	3.9742353	9457	3.9757534	9490	3.9772662
9425	3.9742814	9458	3.9757993	9491	3.9773120
9426	3.9743274	9459	3.9758452	9492	3.9773577
9427	3.9743735	9460	3.9758911	9493	3.9774035
9428	3.9744196	9461	3.9759370	9494	3.9774492
9429	3.9744656	9462	3.9759829	9495	3.9774950
9430	3.9745117	9463	3.9760288	9496	3.9775407
9431	3.9745577	9464	3.9760747	9497	3.9775864
9432	3.9746038	9465	3.9761206	9498	3.9776322
9433	3.9746498	9466	3.9761665	9499	3.9776779
9434	3.9746959	9467	3.9762124	9500	3.9777236

N.	Logarith.	N.	Logarith.	N.	Logarith.
9501	3.9777693	9534	3.9792751	9567	3.9807758
9502	3 9778150	9535	3.9793207	9568	3.9808212
9503	3.9778607	9536	3.9793662	9569	3.9808666
9504	3.9779064	9537	3.9794118	9570	3.9809119
9505	3.9779521	9538	3.9794573	9571	3.9809573
9506	3.9779978	9539	3.9795028	9572	3.9810027
9507	3.9780435	9540	3.9795484	9573	3.9810481
9508	3.9780892	9541	3.9795939	9574	3.9810934
9509	3.9781348	9542	3.9796394	9575	3.9811388
9510	3.9781805	9543	3.9796849	9576	3.9811841
9511	3.9782262	9544	3.9797304	9577	3.9812295
9512	3.9782718	9545	3.9797759	9578	3.9812748
9513	3.9783175	9546	3.9798214	9579	3.9813202
9514	3.9783631	9547	3.9798669	9580	3.9813655
9515	3.9784088	9548	3.9799124	9581	3.9814108
9516	3.9784544	9549	3.9799579	9582	3.9814562
9517	3.9785001	9550	3.9800034	9583	3.9815015
9518	3.9785457	9551	3.9800488	9584	3.9815468
9519	3.9785913	9552	3.9800943	9585	3 9815921
9520	3.9786369	9553	3.9801398	9586	3.9816374
9521	3.9786826	9554	3.9801852	9587	3.9816827
9522	3.9787282	9555	3.9802307	9588	3.9817280
9523	3.9787738	9556	3.9802761	9589	3.9817733
9524	3.9788194	9557	3.9803216	9590	3.9818186
9525	3.9788650	9558	3.9803670	9591	3.9818639
9526	3.9789106	9559	3.9804125	9592	3.9819092
9527	3.9789562	9560	3.9804579	9593	3.9819544
9528	3.9790017	9561	3.9805033	9594	3.9819997
9529	3.9790473	9562	3.9805487	9595	3.9820450
9530	3.9790929	9563	3.9805942	9596	3.9820902
9531	3.9791385	9564	3.9806396	9597	3.9821355
9532	3.9791840	9565	3.9806850	9598	3.9821807
9533	3.9792296	9566	3.9807304	9599	3.9822260
9534	3.9792751	9567	3 9807758	9600	3.9822712

N.	Logarith.	N.	Logarith.	N.	Logarith.
9601	3.9823165	9634	3.9838066	9667	3.9852917
9602	3.9823617	9635	3.9838517	9668	3.9853366
9603	3.9824069	9636	3.9838968	9669	3.9853816
9604	3.9824522	9637	3.9839419	9670	3.9854265
9605	3.9824974	9638	3.9839869	9671	3.9854714
9606	3.9825426	9639	3.9840320	9672	3.9855163
9607	3.9825878	9640	3.9840770	9673	3.9855612
9608	3.9826332	9641	3.9841221	9674	3.9856061
9609	3.9826782	9642	3.9841671	9675	3.9856510
9610	3.9827234	9643	3.9842122	9676	3.9856959
9611	3.9827686	9644	3.9842572	9677	3.9857407
9612	3.9828138	9645	3.9843022	9678	3.9857856
9613	3.9828589	9646	3.9843473	9679	3.9858305
9614	3.9829041	9647	3.9843923	9680	3.9858754
9615	3.9829493	9648	3.9844373	9681	3.9859202
9616	3.9829945	9649	3.9844823	9682	3.9859651
9617	3.9830396	9650	3.9845273	9683	3.9860099
9618	3.9830848	9651	3.9845723	9684	3.9860548
9619	3.9831299	9652	3. 846173	9685	3.9860996
9620	3.9831751	9653	3.9846623	9686	3.9861445
9621	3.9832202	9654	3.9847073	9687	3.9861893
9622	3.9832654	9655	3.9847523	9688	3.9862341
9623	3.9833105	9656	3.9847973	9689	3.9862790
9624	3.9833556	9657	3.9848422	9690	3.9863238
9625	3.9834007	9658	3.9848872	9691	3.9863686
9626	3.9834459	9659	3.9849322	9692	3.9864134
9627	3.9834910	9660	3.9849771	9693	3.9864582
9628	3.9835361	9661	3.9850221	9694	3.9865030
9629	3.9835812	9662	3.9850670	9695	3.9865478
9630	3.9836263	9563	3.9851120	9696	3.9865926
9631	3.9836714	9664	3.9851569	9697	3.9866374
9632	3.9837165	9665	3.9852019	9698	3.9866822
9633	3.9837616	9666	3.9852468	9699	3.9867270
9634	3.9838066	9667	3.9852917	9700	3.9867717

N.	Logarith.	N.	Logarith.	N.	Logarith.
9701	3.9868165	9734	3.9882913	9767	3.9897612
9702	3.9868613	9735	3.9883360	9768	3.9898056
9703	3 9869060	9736	3.9883806	9769	3.9898501
9704	3.9869508	9737	3.9884252	9770	3.9898946
9705	3.9869955	9738	3.9884698	9771	3.9899390
9706	3.9870403	9739	3.9885144	9772	3.9899835
9707	3.9870850	9740	3.9885590	9773	3.9900279
9708	3.9871298	9741	3.9886035	9774	3.9900723
9709	3.9871745	9742	3.9886481	9775	3.9901168
9710	3.9872192	9743	3.9886927	9776	3.9901612
9711	3.9872640	9744	3.9887373	9777	3.9902056
9712	3.9873087	9745	3.9887818	9778	3.9902500
9713	3.9873534	9746	3.9888264	9779	3.9902944
9714	3.9873981	9747	3.9888710	9780	3.9903389
9715	3.9874428	9748	3.9889155	9781	3.9903833
9716	3.9874875	9749	3.9889601	9782	3.9904277
9717	3.9875322	9750	3.9890046	9783	3.9904721
9718	3.9875769	9751	3.9890492	9784	3.9905164
9719	3.9876216	9752	3.9890937	9785	3.9905608
9720	3.9876663	9753	3.9891382	9786	3.9906052
9721	3.9877109	9754	3.9891828	9787	3.9906496
9722	3.9877556	9755	3.9892273	9788	3.9906940
9723	3 9878003	9756	3.9892718	9789	3.9907383
9724	3.9878449	9757	3.9893163	9790	3.9907827
9725	3.9878896	9758	3.9893608	9791	3.9908270
9726	3.9879343	9759	3.9894053	9792	3.9908714
9727	3.9879789	9760	3.9894498	9793	3.9909158
9728	3.9880236	9761	3.9894943	9794	3.9909601
9729	3.9880682	9762	3.9895388	9795	3.9910044
9730	3.9881128	9763	3.9895833	9796	3.9910488
9731	3.9881575	9764	3.9896278	9797	3.9910931
9732	3.9882021	9765	3.9896722	9798	3.9911374
9733	3.9882467	9766	3.9897167	9799	3.9911818
9734	3.9882913	9767	3.9897612	9800	3.9912261

N.	Logarith.	N.	Logarith.	N.	Logarith.
9801	3.9912704	9834	3.9927302	9867	3.9941851
9802	3.9913147	9835	3.9927744	9868	3.9942291
9803	3.9913590	9836	3.9928185	9869	3.9942731
9804	3.9914033	9837	3.9928627	9870	3.9943172
9805	3.9914476	9838	3.9929068	9871	3.9943612
9806	3.9914919	9839	3.9929510	9872	3.9944051
9807	3.9915362	9840	3.9929951	9873	3.9944491
9808	3.9915805	9841	3.9930392	9874	3.9944931
9809	3.9916247	9842	3.9930834	9875	3.9945371
9810	3.9916690	9843	3.9931275	9876	3.9945811
9811	3.9917133	9844	3.9931716	9877	3.9946251
9812	3.9917575	9845	3.9932157	9878	3.9946690
9813	3.9918018	9846	3.9932598	9879	3.9947130
9814	3.9918461	9847	3.9933039	9880	3.9947569
9815	3.9918903	9848	3.9933480	9881	3.9948009
9816	3.9919345	9849	3.9933921	9882	3.9948448
9817	3.9919788	9850	3.9934362	9883	3.9948888
9818	3.9920230	9851	3.9934803	9884	3.9949327
9819	3.9920673	9852	3.9935244	9885	3.9949767
9820	3.9921115	9853	3.9935685	9886	3.9950206
9821	3.9921557	9854	3.9936126	9887	3.9950645
9822	3.9921999	9855	3.9936566	9888	3.9951085
9823	3.9922441	9856	3.9937007	9889	3.9951524
9824	3.9922884	9857	3.9937448	9890	3.9951963
9825	3.9923326	9858	3.9937888	9891	3.9952402
9826	3.9923768	9859	3.9938329	9892	3.9952841
9827	3.9924210	9860	3.9938769	9893	3.9953280
9828	3.9924651	9861	3.9939210	9894	3.9953719
9829	3.9925093	9862	3.9939650	9895	3.9954158
9830	3.9925535	9863	3.9940090	9896	3.9954597
9831	3.9925977	9864	3.9940531	9897	3.9955036
9832	3.9926419	9865	3.9940971	9898	3.9955474
9833	3.9926860	9866	3.9941411	9899	3.9955913
9834	3.9927302	9867	3.9941851	9900	3.9956352

N.	Logarith.	N.	Logarith.	N.	Logarith.
9901	3.9956791	9934	3.9971242	9967	3.9985645
9902	3.9957229	9935	3.9971679	9968	3.9986080
9903	3.9957668	9936	3.9972116	9969	3.9986516
9904	3.9958106	9937	3.9972553	9970	3.9986952
9905	3.9958545	9938	3.9972990	9971	3.9987387
9906	3.9958983	9939	3.9973427	9972	3.9987823
9907	3.9959422	9940	3.9973864	9973	3.9988258
9908	3.9959860	9941	3.9974301	9974	3.9988694
9909	3.9960298	9942	3.9974738	9975	3.9989129
9910	3.9960737	9943	3.9975174	9976	3.9989564
9911	3.9961175	9944	3.9975611	9977	3.9990000
9912	3.9961613	9945	3.9976048	9978	3.9990435
9913	3.9962051	9946	3.9976485	9979	3.9990870
9914	3.9962489	9947	3.9976921	9980	3.9991305
9915	3.9962927	9948	3.9977358	9981	3.9991741
9916	3.9963365	9949	3.9977794	9982	3.9992176
9917	3.9963803	9950	3.9978231	9983	3.9992611
9918	3.9964241	9951	3.9978667	9984	3.9993046
9919	3.9964679	9952	3.9979104	9985	3.9993481
9920	3.9965117	9953	3.9979540	9986	3.9993916
9921	3.9965554	9954	3.9979976	9987	3.9994350
9922	3.9965992	9955	3.9980413	9988	3.9994785
9923	3.9966430	9956	3.9980849	9989	3.9995220
9924	3.9966868	9957	3.9981285	9990	3.9995655
9925	3.9967305	9958	3.9981721	9991	3.9996090
9926	3.9967743	9959	3.9982157	9992	3.9996524
9927	3.9968180	9960	3.9982593	9993	3.9996959
9928	3.9968618	9961	3.9983029	9994	3.9997393
9929	3.9969055	9962	3.9983465	9995	3.9997828
9930	3.9969492	9963	3.9983901	9996	3.9998262
9931	3.9969930	9964	3.9984337	9997	3.9998697
9932	3.9970367	9965	3.9984773	9998	3.9999131
9933	3.9970804	9966	3.9985209	9999	3.9999566
9934	3.9971242	9967	3.9985645	10000	4.0000000

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